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Volume 5

Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR)

Data Manual

Part 4: Summary Aggregations

Prepared by D.I. Gertman, B.G. Gilbert, W.E. Gilmore, W.J. Galyean

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Prepared for
U.S. Nuclear Regulatory
Commission

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ABSTRACT

This volume of a five-volume series summarizes those data currently resident in the first release of the Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) data base. The raw human error probability (HEP) and hardware component failure data (HCFD) contained herein are accompanied by a glossary of terms and the HEP and hardware taxonomies used to structure the data. Instructions are presented on how the user may navigate through the NUCLARR data management system to find anchor values to assist in solving risk-related problems.

Volume V: Data Manual will be updated on a periodic basis so that risk analysts without access to a computer may have access to the latest NUCLARR data. Those users wishing to learn more regarding the computer-based interactive search and report-generation capabilities of the NUCLARR system are referred to the other volumes in the NUREG/CR-4639 series, e.g., Volume I: Summary Description or Volume IV: User's Guide.

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EXECUTIVE SUMMARY

Volume V: Data Manual of NUREG/CR-4639, EGG-2458, is comprised of four individual parts. Part 1: Summary Description introduces aspects of the NUCLARR data base management system and prepares the reader for reviewing data presented in Parts 2, 3, and 4. Part 2: Human Error Probability (HEP) Estimates contains detailed information on the HEP data in the NUCLARR system on the task, cell, and functional group summary level. Part 3: Hardware Component Failure Data (HCFD) presents HCFD contained in NUCLARR; and Part 4: Summary Aggregations offers NUCLARR HEP and HCFD summary aggregations.

A human and hardware reliability analysis group (HHRAG) has been established for the purpose of preparing and processing HEP and HCFD. An external review committee meets at least three times per year to provide technical direction, quality assurance, and make recommendations for upgrades to the NUCLARR system.

The NUCLARR Data Clearinghouse, the primary interface for users of the system, is responsible for the distribution of Volume V and periodic updates of the data which are issued as change pages. The NUCLARR Data Clearinghouse also acts as a resource to answer questions, offer supplemental advice to users, and distribute NUCLARR software.

This report reviews NUCLARR coding systems and data processing procedures. It also highlights the manner in which users can employ the various parts of this volume directly or to establish anchor values for use in addressing generic safety issues. Parts 2, 3, and 4 each begin with an overview and are followed by a task flow and detailed examples on how to use NUCLARR data in order to identify HEP and HCFD rates.

ACKNOWLEDGMENTS

We wish to thank those persons without whom review and evaluation of human error probability and hardware component failure data would have been an arduous task. These include M. Groh and C. Gentillon who, in addition to the above-mentioned duties, had considerable input in deriving the hardware taxonomy and coding system. The software development, implementation, and test and evaluation were herculean efforts on the parts of G. Beers, T. Tucker, and O. Call. We also wish to thank D. Fink for her fine work on the first version of the NUCLARR system.

Thanks are also due H. S. Blackman, for his technical contributions to the NUCLARR system and management support throughout the year. Lastly, we are indebted to T. G. Ryan, our NRC Technical Monitor, for his technical input, attention, and continued support during design and implementation of the data base.

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ACRONYMS

CLCS	consequence limiting control system
CRO	Control Room Operator
EO	Equipment Operator
HEP	human error probability
HCFD	hardware component failure data
HHRAG	Human and Hardware Reliability Analysis Group
INEL	Idaho National Engineering Laboratory
IRRAS	Integrated Reliability and Risk Analysis System
LCB	lower confidence bound
MT	Maintenance Technician
NRC	U.S Nuclear Regulatory Commission
NUCLARR	Nuclear Computerized Library for Assessing Reactor Reliability
PC	personal computer
PRA	probabilistic risk assessment
PSF	performance shaping factors
SARA	Systems Analysis and Risk Assessment System
UCB	upper confidence bound

NUCLEAR COMPUTERIZED LIBRARY FOR ASSESSING REACTOR RELIABILITY (NUCLARR)

VOLUME V: DATA MANUAL

PART 3: HARDWARE COMPONENT FAILURE DATA (HCFD)

1. INTRODUCTION

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is a computer-based data management system used to process, store, and retrieve human error probability (HEP) and hardware component failure data (HCFD) in a ready-to-use format. The NUCLARR data management system was sponsored and developed by the U.S. Nuclear Regulatory Commission (NRC) to provide the risk analysis community a repository of reliability data that can be used to support a variety of existing and developing techniques for performing reactor risk assessment. A special function, the NUCLARR Data Clearinghouse, has been established at the Idaho National Engineering Laboratory (INEL) to assist in providing users of the data management system and data manual with adequate documentation, NUCLARR computer software, expert assistance, data processing, and quality assurance functions.

The NUCLARR system is documented in a series of five volumes (NUREG/CR-4639, EGG-2458).[1-6] Volume I: Summary and Description[1] presents a general introduction to the NUCLARR system. In this document, key information regarding the organization of the NUCLARR system, structural taxonomy for the HEP and HCFD side, and on-line search and retrieval capabilities of the NUCLARR system software are presented. Failure modes, actions, plant codes, document retrieval capability, data origin and survey period are also defined for the reader. In addition, specifications for the hardware and software configuration necessary to run the NUCLARR system are discussed in detail. Points of contact for problems encountered when attempting to use the data base or when attempting to forward new data to the NUCLARR Data Clearinghouse are also included.

Volume II: Programmer's Guide[2] provides information necessary for maintaining the software programs resident in the NUCLARR system. This includes modules for adding new equipment or actions to the taxonomy matrices and preprocessing programs used for converting raw data estimates of error into processed estimates with the appropriate confidence bounds and error factors. Also included are procedures for maintaining and modifying help screens, equipment and plant codes, log plot programs, and computational aggregation algorithms contained in NUCLARR.

Volume III: Data Base Management Guide for Processing Data and Revising the Data Manual[3] provides the input procedures used by the NUCLARR Data Clearinghouse for extracting suitable data from candidate source documents and entering this information into the NUCLARR system.

Volume IV: User's Guide[4-6] provides users with step-by-step procedures for locating, reviewing, and combining data extracted from the NUCLARR system. This volume also provides ad-hoc search strategies and examples of where the analyst may or may not wish to use the aggregation routines offered by the NUCLARR system.

Volume V: Data Manual is the fifth volume of a five-volume set and is meant to serve the needs of and accommodate those who do not have access to personal computers; it provides those users the means to review all data available in the NUCLARR system. Volume V is divided into four parts. Part 1: Summary Description provides the user with a top-level review of the type of data, both HEP and HCFD, resident in the NUCLARR data management system. Readers may supplement the information contained in Part 1 of Volume V by addressing Parts 2, 3, and 4 in the series: Part 2: Human Error Probability (HEP) Data; Part 3: Hardware Component Failure Data (HCFD); and this report, Part 4: Summary Aggregations. Volume V has been designed to be a stand-alone document. For analysts interested in HEP, Volume V, Part 2, provides 16 two-dimensional matrices used to determine equipment and human action codes. The analyst searches for data items by combining equipment characteristics and human actions. These codes are used to locate all related data in the data appendices associated with Part 2. Definitions for all equipment are also presented in Part 2. Similarly, the coding sequences presented in Part 3 for the HCFD taxonomy section of the Data Manual may be used to identify all relevant HCFD for a particular component. Part 4 presents summary aggregations across equipment groups for HEP and HCFD.

Subscribers to the NUCLARR data base management system will receive a series of diskettes, allowing them to use the system at their own location. Minimum utility specifications require the analyst to have an IBM-compatible[a] personal computer with math co-processor, 20-megabyte hard disk, 640K of random access memory, and no auto load, sys.cache file, or virtual disk commands which reduce the 640K needed to run NUCLARR.

Any reader desiring copies of the individual volumes listed in the NUCLARR series or a copy of NUCLARR software should contact the NUCLARR Data Clearinghouse at the address listed below:

David I. Gertman
NUCLARR Data Clearinghouse
Idaho National Engineering Laboratory
P. O. Box 1625
Idaho Falls, ID 83415 USA
Telephone: FTS 583-0652; commercial 208-526-0652

Questions regarding the NUCLARR program may be directed to the address listed above or to the NRC Technical Monitor:

Thomas G. Ryan
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
5640 Nicholson Lane, NL/N-316
Rockville, MD 20852 USA
Telephone: FTS 492-3550; commercial 301-492-3550

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[a] Mention of specific products and/or manufacturers in this document implies neither endorsement or preference nor disapproval by the U.S. Government, any of its agencies, or EG&G Idaho, Inc., of the use of a specific product for any purpose.

2. ORGANIZATION

Part 1 of Volume V of NUREG/CR-4639 is organized to familiarize potential users with the NUCLARR data base management system, provide orientation for data base usage without the aid of a computer, inform users on how to identify and retrieve the data which will meet their needs, and instruct them on how to access the two types of data, HEP and HCFD, currently residing in the system. All the taxonomic information needed in order to understand how the NUCLARR system is organized has been provided in this overview.

HEP data are organized in matrices by human action; equipment being monitored, used, tested or calibrated; whether errors commited are errors of commission or omission; and whether or not the data source specifies if recovery actions have been considered in the calculation of the HEP point estimate.

HCFD are organized by equipment (component) type and failure mode. Additional coding exists, such as plant codes, normal operating state, and survey period.[a] Listings of all the HEP and HCFD sources for data currently entered in NUCLARR may be found in Section 3.3 of this report.

The appendices to Parts 2, 3, and 4 of Volume V present HEP, HCFD and summary aggregation data, respectively. As part of an ongoing effort, other data sources will be identified, processed, and, where appropriate, entered into the NUCLARR data base management system.

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[a] For readers wishing to broaden their understanding of HCFD, the following references are available from the NUCLARR Data Clearinghouse: EGG-REQ-7775, Aggregation Methods for Component Failure Data in the Nuclear Computerized Library for Assessing Reactor Reliability;[7] EGG-REQ-7742, Requirements for the Entry of Component Failure Data in NUCLARR;[8] and NUCLARR Volume IV: User's Guide.[4-6]

Part 4: Summary Aggregations begins with an introduction to the NUCLARR series of reports and presents the nature of data and data structures contained within the NUCLARR system. This overview is followed by a detailed task flow for users wishing to perform a data search of either HEP or HCFD records contained in the NUCLARR system. The search procedure is highlighted through the use of two examples. All necessary tables, data identification codes, plant codes, and raw data are provided in appendices located in the back of this report. As an aid to the user, simple summary aggregations for both cell and functional group summary information have been provided. Finally, users of the NUCLARR system are reminded that there will be periodic updates to the data manual and that any quantitative data that they might have should be sent to the NUCLARR Data Clearinghouse for inclusion in the NUCLARR data management system.

3. DATA QUALIFICATION

A number of parameters can be used to describe and define error probability and rate-based data. Popular examples for HEP include performance shaping factors (PSFs), task performance time, whether the errors committed where those of omission or commission, whether there was opportunity for recovery from the error, etc. Likewise, hardware failure rate descriptors may include such parameters as survey period, plant identification, component application, and distribution type (e.g., lognormal, gamma, Poisson). All events contained in the HCFD side of the NUCLARR system concern component failures, and all components are treated equally. The hierarchical structure merely serves to organize data. Authors of documents reviewed to date tend to differ in what they select as descriptive characteristics of the task and work environment and the method by which data were collected. In all cases, then, it is the user who must be the ultimate arbiter as to the quality of data and which documents should be included in a data search.

A review of existing data bases and the open literature reveals a great variety in the quality of data and in the manner in which they are reported. As a result, a series of stringent criteria have been introduced to ensure that data contained in the NUCLARR system are of the highest quality. Prior to the current implementation, detailed set(s) of screening procedures were developed which would allow all reasonable, quantified data a place within the NUCLARR system. The results of this effort are discussed below for both the HEP and HCFD sides of the NUCLARR data management system. Likewise, the aggregation methods and algorithms used in NUCLARR are sophisticated and have, over the past few years, undergone extensive review by outside consultants who were knowledgeable in probabilistic risk assessment (PRA) and human reliability analysis techniques.

3.1 The NUCLARR Data Clearinghouse and Quality Control

The NUCLARR Data Clearinghouse includes human factors, risk analysis, and software personnel who are responsible for all contact with users of the NUCLARR system and for providing documentation and support services for software maintenance. NUCLARR Data Clearinghouse personnel are further responsible for the distribution of user documentation, including training course documentation, and diskettes containing NUCLARR software. They also review updated versions and revised data pages for Volume V: Data Manual.

A library has been established at the Clearinghouse wherein copies of all five volumes of the NUCLARR series are maintained and kept up to date. Clearinghouse personnel also track requests for documents and ensure that requestors receive NUCLARR materials in a timely fashion. A small, personal-computer-based management system which keeps account of each new transaction has been implemented in dBaseIII+ software expressly for this purpose.

The human and hardware reliability analysis group (HHRAG) plays a major role in the NUCLARR data management process, distinct from the NUCLARR Data Clearinghouse function. The HHRAG reviews data sources for suitability and then processes those data which are qualified for inclusion in the NUCLARR system. The personnel who make up the HHRAG are experienced in one or more of the following disciplines: nuclear power plant operations, human reliability analysis, probabilistic risk analysis, system reliability, and generic safety issues. An external review committee, composed of members internal and external to the NUCLARR project team, meets three times per year to process and perform quality assurance checks of the data resident in the system. Review committee members are selected with approval of the NRC Technical Monitor, and members serve on a rotating basis. They make suggestions as to sources of new, meaningful HEP and HCFD.

The external review committee also takes under consideration recommendations for changes or upgrades to the NUCLARR data management system, including additions to data base taxonomies which will result in more efficient processing, coding, and retrieval of data. One such recommendation recently implemented in NUCLARR calls for the addition of a log plot capability for both HEP and HCFD sides of the data management system.

3.2 Plant (Utility) Identification Codes

Codes for all plants in the United States which are used to identify data for both HEP and HCFD are listed in Table 1.

3.3 Data Sources

A variety of sources are eligible for inclusion in NUCLARR. With the exception of PRA sources, most data sources (e.g., documents or data bases) present either HEP or HCFD. An example of an HEP data source would be NUREG CR-1278, Handbook of Human Reliability with Emphasis on Nuclear Power Plant Applications.[9]* An HCFD source could be any raw, plant-specific data contained in a PRA. HCFD sources could also include generic data rates, such as those contained in IEEE STD 500, "Guide of the Collection and Presentation of Electrical, Electronic, Sensing Component, and Mechanical Equipment Reliability Data for Nuclear Power Generator Statistics,"[10] or WASH 1400, Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants.[11] The sections below list some of the sources and potential sources entered to date. Readers are encouraged to submit any raw or processed HEP or HCFD directly to the NUCLARR Data Clearinghouse by sending it to the address specified on page 3 of this report.

3.3.1 HEP Sources

Sources of HEP data entered to date are listed in Table 2. In addition, part of the HERAS data base, a collection of the HEP portion of 19 plant PRAs, has also been entered. Raw data from these various sources are found in appendices to Part 2 of Volume V.

3.3.2 HCFD Sources

Sources of HCFD entered to date are listed in Table 3. Raw failure rate data from these various sources are found in appendices to Part 3 of Volume V.

TABLE 1. FACILITY IDENTIFIERS

PLANT UNIT NAME	FID	PLANT UNIT NAME	FID	PLANT UNIT NAME	FID
ARKANSAS 1	ANO1	GRAND GULF	GGS1	POINT BEACH 2	PBH2
ARKANSAS 2	ANO2	HADDAM NECK	HNP1	PRAIRIE ISLAND 1	PIN1
BEAVER VALLEY 1	BVS1	HATCH 1	EIH1	PRAIRIE ISLAND 2	PIN2
BEAVER VALLEY 2	BVS2	HATCH 2	EIH2	QUAD CITIES 1	QAD1
BIG ROCK POINT	BRP1	HOPE CREEK	HCS1	QUAD CITIES 2	QAD2
BRAIDWOOD 1	BRS1	HUMBOLDT BAY 3	HMB3	RANCHO SECO	RSS1
BROWNS FERRY 1	BRF1	INDIAN POINT 2	IPS2	RIVER BEND	RBS1
BROWNS FERRY 2	BRF2	INDIAN POINT 3	IPS3	ROBINSON 2	HBR2
BROWNS FERRY 3	BRF3	KEWAUNEE	KNP1	SALEM 1	SGS1
BRUNSWICK 1	BEP1	LA CROSSE	LBR1	SALEM 2	SGS2
BRUNSWICK 2	BEP2	LASALLE 1	LSC1	SAN ONOFRE 1	SOS1
BYRON 1	BYS1	LASALLE 2	LSC2	SAN ONOFRE 2	SOS2
BYRON 2	BYS2	LIMERICK	LGS1	SAN ONOFRE 3	SOS3
CALLAWAY	CAY1	MAINE YANKEE	MYP1	SEABROOK	SBK1
CALVERT CLIFFS 1	CCN1	MCGUIRE 1	MGS1	SEQUOYAH 1	SNP1
CALVERT CLIFFS 2	CCN2	MCGUIRE 2	MGS2	SEQUOYAH 2	SNP2
CATAWBA 1	CNS1	MILLSTONE 1	MNS1	SHEARON HARRIS 1	SHS1
CATAWBA 2	CNS2	MILLSTONE 2	MNS2	SHOREHAM	SNS1
CLINTON 1	CPP1	MILLSTONE 3	MNS3	ST. LUCIE 1	SLS1
COOK 1	DCC1	MONTICELLO	MNP1	ST. LUCIE 2	SLS2
COOK 2	DCC2	NINE MILE PT. 1	NMP1	SUMMER	VCS1
COOPER STATION	CPR1	NINE MILE PT. 2	NMP2	SURRY 1	SPS1
CRYSTAL RIVER 3	CRP3	NORTH ANNA 1	NAS1	SURRY 2	SPS2
DAVIS-BESSE	DBS1	NORTH ANNA 2	NAS2	SUSQUEHANNA 1	SES1
DIABLO CANYON 1	DCP1	OCONEE 1	NEE1	SUSQUEHANNA 2	SES2
DIABLO CANYON 2	DCP2	OCONEE 2	NEE2	THREE MILE ISL. 1	TMI1
DRESDEN 1	DRS1	OCONEE 3	NEE3	THREE MILE ISL. 2	TMI2
DRESDEN 2	DRS2	OYSTER CREEK	OCP1	TROJAN	TNP1
DRESDEN 3	DRS3	PALISADES	PAL1	TURKEY POINT 3	TPS3
DUANE ARNOLD	DAC1	PALO VERDE 1	PAV1	TURKEY POINT 4	TPS4
FARLEY 1	JMF1	PALO VERDE 2	PAV2	VERMONT YANKEE 1	VYS1
FARLEY 2	JMF2	PALO VERDE 3	PAV3	VOGTLE 1	ANV1
FERMI 2	EFP2	PEACH BOTTOM 2	PBS2	WASH. NUCLEAR 2	WNP2
FITZPATRICK	JAF1	PEACH BOTTOM 3	PBS3	WATERFORD 3	WGS3
FORT CALHOUN	FCS1	PERRY	PNP1	WOLF CREEK	WCS1
FORT ST. VRAIN	FSV1	PILGRIM	PPS1	YANKEE-ROWE	YKR1
GINNA	REG1	POINT BEACH 1	PBH1	ZION 1	ZIS1
				ZION 2	ZIS2

TABLE 2. HUMAN ERROR PROBABILITY REFERENCES LISTED BY DOCUMENT NUMBER

Document Number	Reference
1-62	S. J. Munger, R. W. Smith, and D. Payne, An Index of Electronic Equipment Operability: Data Store, AIR-C43-1/62/RP(1), January 1962.
1/75	U.S. Nuclear Regulatory Commission, Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, WASH-1400, NUREG-75/014, October 1975.
1-81	D. D. Carlson, Reactor Safety Study Methodology Applications Program: Sequoyah #1 PWR Power Plant, NUREG/CR-1659, February 1981.
1-82	D. A. Topmiller et al., Human Reliability Data Bank for Nuclear Power Plant Operations Volume 1: A Review of Existing Human Reliability Data Banks, NUREG/CR-2744, December 1982.
1-83	A. D. Swain and H. E. Guttman, Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, NUREG/CR-1278, August 1983.
1/84	A. N. Beare et al., A Simulator Based Study of Human Errors in Nuclear Power Plant Control Room Tasks, NUREG/CR-3309, January 1984.
2/84	K. Comer, D. Seaver, W. Stillwell, and C. Gaddy, Calculating Human Reliability Estimates Using Expert Judgement, NUREG/CR-3688, Vol. 2, November 1984.
3-84	W. R. Sugnet, G. J. Boyd, and S. R. Lewis, Oconee PRA, NSAC-60, Vol. 1, June 1984.
4/84	A. C. Payne et al., Interim Reliability Evaluation Program: Analysis of the Calvert Cliffs Unit 1 Nuclear Power Plant, NUREG/CR-3511, Vols. 1 and 2, August 1984.
1/85	Luckas, O'Brien, Perline, and Spettell, Operator Actions in Anticipated Transient Without Scram (ATWS-TC) Sequence for Peach Bottom Plant, October 1985.
2/85	J. N. O'Brien and Spettell, Uses of Human Reliability Analysis Probabilistic Risk Assessment Results to Resolve Personnel Performance Issues That Could Affect Safety, NUREG/CR-4103, March 1985.
2/86	R. C. Bertucio et al., Analysis of Core Damage Frequency from Internal Events: Surrey, Unit 1, NUREG/CR-4550, Vol. 3, 1986.

TABLE 2. (CONTINUED)

Document Number	Reference
3/86	Kolaczkowski et al., Analysis of Core Damage Frequency from Internal Events: Peach Bottom, Unit 2, NUREG/CR-4550, Vol. 4, October 1986.
1/87	M. T. Drouin et al., Analysis of Core Damage Frequency from Internal Events: Grand Gulf, Unit 1, NUREG/CR-4550, Vol. 6, April 1987.
2/87	R. C. Bertucio et al., Analysis of Core Damage Frequency from Internal Events: Sequoyah, Unit 1, NUREG/CR-4550, Vol. 5, February 1987.

TABLE 3. HARDWARE COMPONENT FAILURE DATA REFERENCES LISTED BY DOCUMENT NUMBER

Document Number	Reference
200-81	Big Rock Point Probabilistic Risk Assessment, Consumer Power Company, March 1981.
205-86	Connecticut Yankee Probabilistic Safety Study, NUSCO 149, February 1986.
209-82	Indian Point Probabilistic Risk Assessment, Pickard, Lowe, and Garrick, Inc., December 1982.
211-85	Millstone Probabilistic Risk Assessment, Northern Utilities, July 1985.
212-81	Electric Power Research Institute (Nuclear Safety Analysis Center), A Probabilistic Risk Assessment of Oconee Unit 3, NSAC-60, Vols. 1-4, June 1984.
213-81	Zion Probabilistic Risk Assessment, Pickard, Lowe, and Garrick, Inc., September 1981.
54-75	Reactor Safety Study, Appendix III--Failure Data, WASH-1400, NUREG-75/014, U.S. Nuclear Regulatory Commission, 1975 - data under review, some entry
53-83	IEEE Standard 500, Nuclear Power Engineering Committee, IEEE Power Engineering Society, 1984.
63-82	NUREG/CR-1205, Data Summaries of Pumps at U.S. Nuclear Power Plants, Rev. 1, January 1980.
36-85	NUREG/CR-3831, The In-Plant Reliability Data Base for Nuclear Plant Components: Interim Report for Diesel Generators, Batteries, Chargers and Inverters, January 1985.
133-86	Electric Power Research Institute, The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants, NSAC 108, September 1986.

4. CRITERIA FOR DATA INCLUSION

The following sections describe the specific criteria used to qualify data sources for entry into the NUCLARR system. Only those data that have met the criteria specified in Sections 4.1 and 4.2 are included in the raw data appendices of Parts 2 and 3 of Volume V.

4.1 HEP Side

Data entered in the HEP side of the NUCLARR system must meet three criteria:

1. They must specify a human action;
2. They must specify a piece of equipment or a system; and,
3. They must be quantitative in nature. The most preferable data are in the form of an HEP statement with upper and lower confidence bounds. Data presented as median values with errors, or simply as error observed over the number of opportunities for error, are also acceptable.

If data obtained from a study meet the criteria specified above but are lacking in scientific merit, they may be excluded from the data base by the HMRAG review group. Exclusion, although possible, is the exception rather than the rule. The NUCLARR user is expected to be relatively sophisticated and able to select those documents he or she feels to be germane to the problem under investigation.

Data reported in one source which are simply repeated in a second source are also not included. For example, once data from WASH-1400[11] have been entered in NUCLARR, a review article which merely repeats those data would not be suitable for inclusion in NUCLARR. If the origin of data is other than in the document being reviewed and data have been modified by expert judgment or task analysis methods, the transformed data are available for the analyst's review and the original source is referenced. These data are not aggregated. This procedure helps prevent the possibility of over-representation of data within the data base.

4.2 HCFD Side

Data requirements for the HCFD side of the NUCLARR system are limited to time- and demand-based estimates and do not, at the present time, include other types of data, such as unavailability or common-cause. Losses of function are not included, as they are confounded with function losses due to human intervention, i.e., error. What is included, then, are events where components were in need of repair, replacement, or adjustment.

Furthermore, components selected for inclusion in the NUCLARR system are those that are typically involved in basic events in fault-tree models of nuclear power plant systems. They also tend to be those types of components most often found in safety systems.

HCFD entries have been restricted to failures within specified component boundaries. Secondary failures have been excluded; i.e., failures due to conditions existing outside the boundary that produce conditions exceeding the design basis of the component. Thus, closely associated equipment that is physically coupled is included, and failures caused by common-support systems are not.

Ideal failure rate data, therefore, depend upon the component and its immediate environment and application.

In summary, HCFD accepted for inclusion into the NUCLARR system must have:

- A description of component and failure mode; and
- A probability value; i.e., number of failures and number of operating hours or demands, or the rate itself.

When available, an account of plant operating conditions or the state in which the failures occurred is also preserved in the data base. Finally, raw data are preferred over rates which have made use of Bayesian updates.

5. AGGREGATION FEATURES

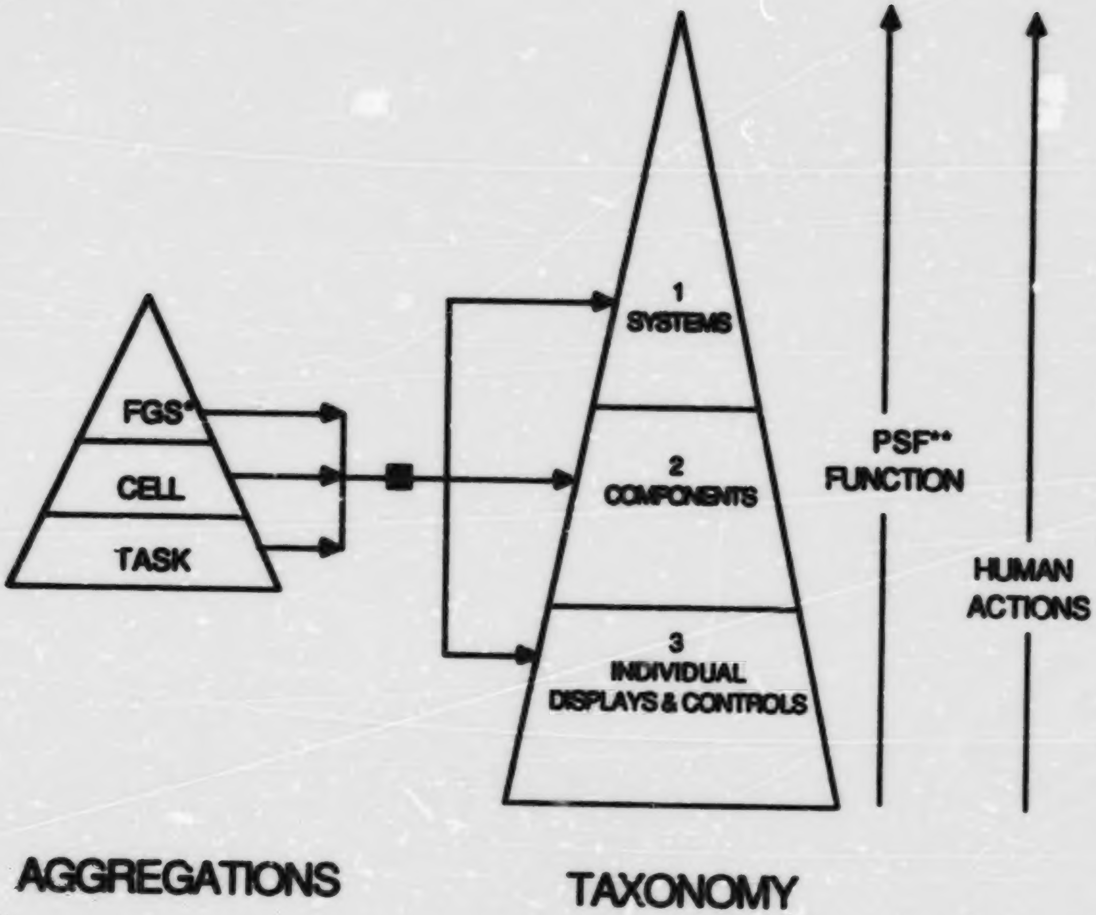
The sections which follow present the aggregation features of the NUCLARR system for both HEP and HCFD. For in-depth information regarding the aggregation features and corresponding algorithms resident in the NUCLARR system, the reader is referred to Section 3.3 of Volume IV: User's Guide, Part 3: NUCLARR System Description.[6]

5.1 HEP Data Treatment

The NUCLARR system automatically makes a number of calculations for each HEP source data point. Depending on the degree of detail available when data are first entered, the NUCLARR system will compute upper confidence bounds (UCBs); lower confidence bounds (LCBs), error factors, medians, means, errors, and opportunities for error. All of these data are present for the reader's review. Separate aggregation algorithms are applied to compute task statement HEPs, cell HEPs, and functional group HEPs. These aggregations are computed for each of the three levels of the the NUCLARR system taxonomy. Figure 1 presents this HEP configuration with each of the aggregations being nested in each of the equipment taxonomy levels. Aggregation values are derived in the following manner.

For computing task statement HEP aggregations, raw source data are compared for consistency using a homogeneity test based upon the binomial distribution. Statistically consistent HEPs are pooled; the task HEP is the total number of errors divided by the total number of opportunities. Based upon binomial distribution characteristics, the UCB and LCB limits are computed.

For computing cell HEP aggregations, HEPS from functionally related tasks are gathered together and are assumed to be lognormally distributed. Therefore, the sum of the logs of the HEPS for a given cell is divided by the number of HEPs, and the antilogarithm is calculated to determine the cell HEP. Calculation of the error factor for the cell HEP is based on taking the root mean square of the log ratios of task statement UCBs to LCBs.


1
SYSTEMS
FGS*
CELL
TASK
2
COMPONENTS
3
INDIVIDUAL
DISPLAYS & CONTROLS
PSF**
FUNCTION
HUMAN
ACTIONS
AGGREGATIONS
TAXONOMY

* FUNCTIONAL GROUP SUMMARY
** PERFORMANCE SHAPING FACTORS

Figure 1. Relationship of NUCLARR HEP aggregations and taxonomy.

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The functional group summary is the highest level of HEP data allowed in the NUCLARR system. For computing functional group HEP aggregations, calculations are based on task level HEPs, just as they are in the cell aggregation calculations. In this case, the aggregation employs task HEPs functionally grouped not for one cell but taken across a set of cells. This distribution of HEPs is assumed to be lognormal. Again, the sum of the logs of the HEPs for these tasks comprising the functional group is divided by the number of HEPs, and the antilogarithm is calculated to determine the functional group HEP. Calculation of the error factor for the functional group HEP is based on taking the root mean square of the log ratios of task statement UCBs to LCBs.

Those readers wishing to sample raw data from Part 2 of Volume V and manually compute task, cell, and functional group HEPs are referred to Volume IV in this series for procedures outlining manual calculation methods.

5.2 HCFD Treatment

There are two sets of aggregations within the HCFD side of the NUCLARR system. The first set is performed automatically when data are first entered. The second set is only applied when the user performs custom aggregations with the computer-based version of the NUCLARR system. Although time-consuming, it would be possible to perform these same aggregations manually. The methods used in the NUCLARR system recognize two types of data beside raw data--tolerance interval information and confidence intervals. Generic data are acceptable input; e.g., WASH 1400[11] data are available for review by the analyst using the NUCLARR system, but are not as preferred by the system as are raw data.

The automatically executed algorithms are driven by the nature of the data themselves. Acceptable combinations include homogeneous/raw; homogeneous/tolerance information available; homogeneous/no tolerance information available; preaggregated data/tolerance information available; and preaggregated data/no tolerance information available. Homogeneous data by definition are from equipment having a constant failure rate; raw data are the number of failures and the associated demand, or exposure time. Details regarding different Bayes procedures, raw data conversion, and weighted and unweighted fits to lognormal distributions are contained in Volume IV of this series.

The aggregation procedure computes failure probabilities at the following five separate event levels: (a) component/failure mode group; (b) component/failure mode; (c) component/design/failure mode group; (d) component/design/failure mode; and (e) component/design/failure mode/normal state. Basic NUCLARR system output is a point estimate and tolerance bound, with supporting information about the number of records or raw data points in the aggregation, normal operating condition (state), failure mode, component, and design. Supporting information is available regarding each raw data point contributing to the aggregated value. Aside from those categories cited above, this information includes component application, aggregation type, survey/period, origin of failure and exposure data, plant identification code, and systems and subsystem information.

Additionally, the NUCLARR system calculates median, mean, error factor, and upper tolerance bounds for each data point. The treatment of data in these calculations for raw data is described in more detail in Volume IV of this series.

6. DATA STRUCTURE

The sections which follow describe briefly the data structure for both the HEP and HCFD contained in the NUCLARR system.

6.1 Matrix Schema for HEP Data

A hierarchical approach is used in the HEP side of the NUCLARR system; this supports the level of detail appropriate to the needs of the risk analyst. Data are nested under equipment categories. For example, Level 1 refers to equipment systems, such as the emergency core cooling system and is further identified by nuclear steam supply system vendor. Level 2 refers to equipment components, such as pumps and valves. Level 3 refers to individual controls or displays, such as a meter or CRT. Action verbs keyed distinctly to each of the three levels are recorded as well. For Levels 1 and 2, these action verbs are specified for each of three types of personnel: control room operators, equipment operators, and maintenance technicians.

The reader is referred to Appendix B of Part 2, where equipment characteristics are listed by row and human actions are listed by column for each matrix. The intersection of an equipment characteristic (identifier) with a human action characteristic (identifier) within a particular matrix constitutes a cell. There is a unique numeric identifier associated with each cell. In addition, there are functional group summary cells that contain data combined from lower cells. For example, the functional group summary cell for valves includes globe valves, needle valves, gate valves, etc. Each of the functional group summary cells also has a unique identifier.

Individual data records also contain a host of information not specified by the matrix. These are addressable on-line when using the ad-hoc search mode of the NUCLARR system and include plant code, performance shaping factors, time available to the operator or crew, mode (omission or commission), whether recovery was considered, plant/sequence, source document used, and data origin, e.g., expert judgment, laboratory, or field data. These additional features which help to bound the HEP estimates are only present in the data records section of Part 2.

6.2 Matrix Schema for HCFD

Contained within Volume V, Part 3, are failure data for components typically used at nuclear power plants. All plant codes, component codes, distribution codes, application codes, and failure mode codes defined in EGG-REQ-7742[8] have been implemented.

Data are structured first by event. There are five basic event levels:

1. Component category.
2. Component type (or just component).
3. Component design.
4. Failure mode.
5. Normal state.

In addition, data are organized by:

- Application (environment or other parameters);
- Plant identifier;
- Safety grade or not;
- Document ID;
- Reference ID;
- Whether control circuits are included;

- Severity of failure;

- Failure data origin (expert judgment, plant experience, etc.);

- Exposure data origin and data record type (log books, utility base records, cycle counters, and total operating hours); and

- Failure data themselves, where failure data may take the form of median rate or probability, mean failure rate or probability, units - demand or per hour, confidence interval, tolerance interval, error factor, variance, Bayesian update flag, and the data distribution.

7. HOW TO USE THE DATA MANUAL

Prior to attempting to extract meaningful data from the Data Manual, it is best to become acquainted with its various parts. Figure 2 presents a series of steps depicting the flow of actions related to use of the various parts of the Data Manual. Each part of Volume V contains within itself a task flow and example of how to use the data found therein.

In Figure 2, Step 1.0, calls for establishing PRA data requirements. In the case of obtaining HEP data requirements, this requires that the analyst construct a problem statement of sufficient detail to indicate the involvement of control room operators, auxiliary operators, or maintenance personnel and the equipment or systems they would use in meeting such a problem. In the case of obtaining HCFD, the analyst would want to determine the components of interest for a particular plant sequence, the normal operating conditions of that piece of equipment, and the failure mode(s) involved.

Step 2.0 requires that the analyst review Volume I: Summary Description (NUREG/CR-4639) to get an overview of the capabilities and types of data resident in the NUCLARR system. Users may review this volume to find out about other documents in the NUCLARR series or to find a point of contact at the NUCLARR Data Clearinghouse for assistance in determining whether or not the NUCLARR system is appropriate to their needs.

Step 3.0 calls for the analyst to review in-house resources. The NUCLARR system may be addressed by use of either computer facilities or by following procedures outlined in Volume V. If the user has access to a personal computer with the capability to accept the NUCLARR system, then the analyst should acquire the NUCLARR computerized data base (see Step 3.1). Volume IV: User's Guide should be consulted for the procedures involved in carrying out descriptive or ad-hoc searches.

Steps 3.2 and 3.2.1 indicate that the analyst who has no personal computer or copy of NUCLARR software should consult Part 1 of Volume V.

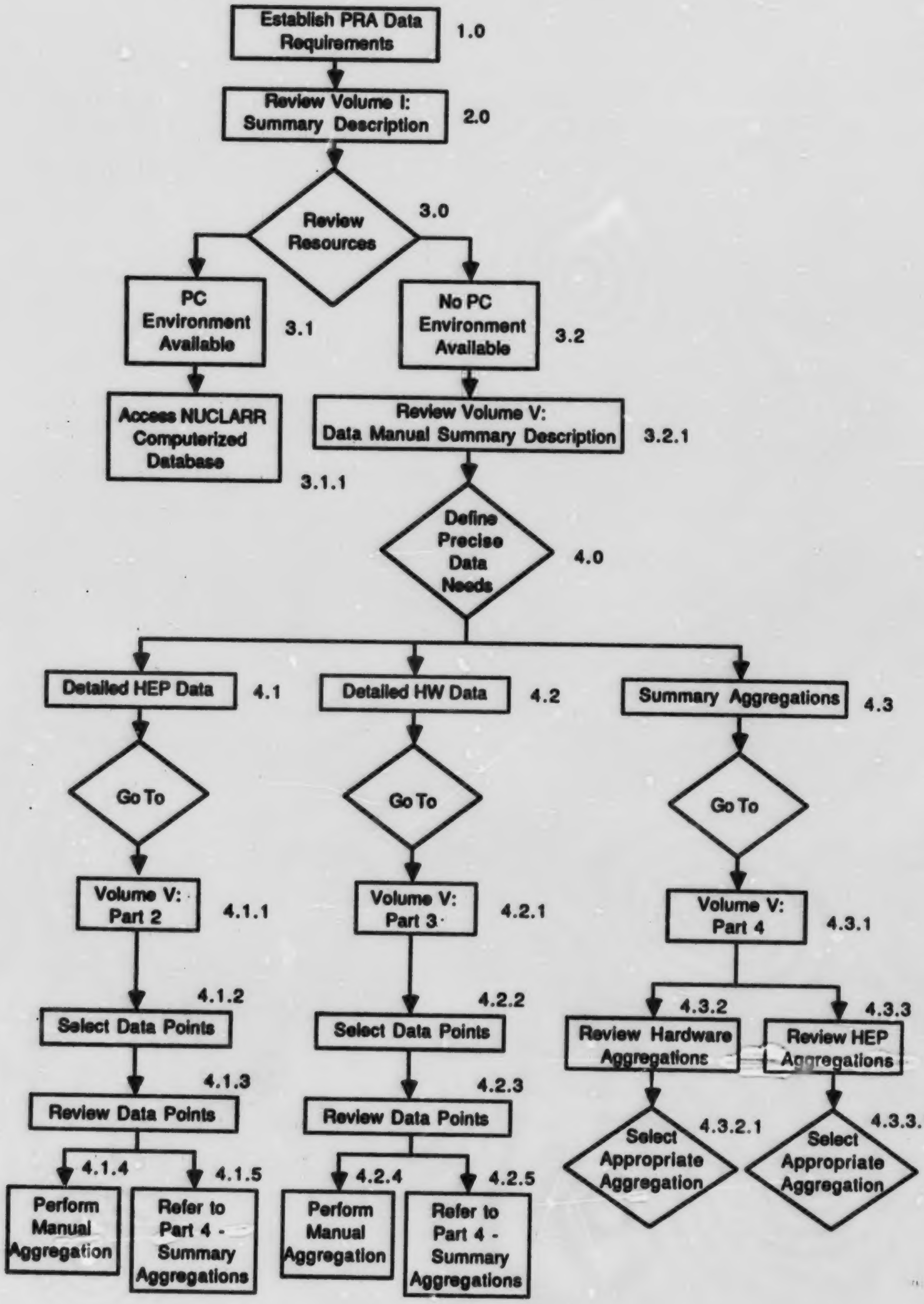
Establish PRA Data Requirements
1.0
Review Volume I: Summary Description
2.0
Review Resources
3.0
PC Environment Available
3.1
No PC Environment Available
3.2
Access NUCLARR Computerized Database
3.1.1
Review Volume V: Data Manual Summary Description
3.2.1
Define Precise Data Needs
4.0
Detailed HEP Data
4.1
Detailed HW Data
4.2
Summary Aggregations
4.3
Go To
Go To
Go To
Volume V: Part 2
4.1.1
Volume V: Part 3
4.2.1
Volume V: Part 4
4.3.1
4.1.2
Select Data Points
4.2.2
Select Data Points
4.3.2
Review Hardware Aggregations
4.3.3
Review HEP Aggregations
4.1.3
Review Data Points
4.2.3
Review Data Points
4.3.2.1
Select Appropriate Aggregation
4.3.3.1
Select Appropriate Aggregation
4.1.4
Perform Manual Aggregation
4.1.5
Refer to Part 4 - Summary Aggregations
4.2.4
Perform Manual Aggregation
4.2.5
Refer to Part 4 - Summary Aggregations

Figure 2. Task flow for Volume V.

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Step 4.0 requires that the analyst determine more precisely his or her data needs and whether these needs might be best met by going to detailed or summary HEP and/or HCFD information. For example, if detailed HEP data are desired (see Step 4.1), then the analyst may address data located in Part 2 such as " Control room operator fails to manually activate the consequence limiting control system (CLCS) at Surry, Unit 1, data from NUREG CR-4550."

If Part 2: HEP Estimates has been selected (see Step 4.1.1), the analyst will use the procedures outlined in Part 3 of Volume V to go to the correct cells (Step 4.1.2), review data including factors which may limit the utility of particular data points to the analysis in question, and, finally, obtain data points appropriate to the data analysis at hand (Step 4.1.3).

If only a subset of rates in Part 2 are acceptable to the analyst, then he or she may wish to perform a manual aggregation (Step 4.1.4) or select the anchor value most appropriate to the problem at hand. Such might be the case if, for example, the analyst were only interested in rates for crew errors committed at Babcock & Wilcox plants during loss-of-offsite power sequences. If a broader scope of aggregation is desired due either to the nature of the problem at hand or to lack of specific data being available in the open literature, the user may wish to go to Part 4: Summary Aggregations (see Step 4.1.5). For example, the user may want to determine a median HEP estimate for all occasions where control room crews have attempted to initiate high pressure injection in the presence of various plant transients.

If detailed HCFD are desired (see Step 4.2), then the analyst may address data located in appendices to Part 3: Hardware Component Failure Data, such as "failure for diesel generator with diesel engine driver, normally in standby, fails to start, raw data = 6 failures over 1340 demands, data collection period 1974 through 1983, at Zion Station."

If Part 3 has been selected (see Step 4.2.1), the analyst will use the procedures outlined therein to go to the correct cells (Step 4.2.3); review data, including factors related to the component rates which may limit their utility to the analysis in question; and, finally, manually select those data points most appropriate (Step 4.2.4). Once these data points are selected, the user may wish to aggregate the data (4.2.4) or select the anchor value most appropriate to the problem at hand. If only a general screening value is needed or if a very large number of HCFD rates are observed, the analyst may wish to review Part 4: Summary Aggregations (see Step 4.2.5)

If a generic anchor value (e.g., HEP or HCFD rate) is all that is required, then the analyst may wish to access directly summary aggregation information contained in Part 4: Summary Aggregations (see Steps 4.3 and 4.3.1). Summary aggregations for the HCFD side of the NUCLARR system are addressed as part of Step 4.3.2 and include component failure rates in the form "check valves, fails to operate group, design equals all." Note that demand and hourly aggregations are listed separately. Furthermore, aggregations are collapsed across plant, survey period, and reference document. If a user requires data on the survey period and plant, then Part 3 should be used as a reference instead.

Representative data to be reviewed as part of Figure 2, Step 4.3.3, include detailed summary aggregations across HEP functional cells, such as those contained in cell 0429001, the summary of main steam systems, where rates and bounds are presented along with classification by error type (omission or commission) and by virtue of the extent to which recovery actions are represented in the calculations. Note that these aggregations are collapsed across performance shaping factors and nuclear power plant. Users requiring information on the time necessary for a crew to respond to plant/transient conditions should refer instead to Part 2.

8. HOW TO PERFORM MANUAL SEARCHES OF SUMMARY AGGREGATIONS

This section expands by means of example and corresponding figures the detail present in the overview task flow presented as Figure 2 of this report. Whereas Figure 2 allows for branching to either HEP or HFCD data, the following sections are geared specifically for those users who wish to perform a manual search of summary aggregations for HEP and HCFD data, respectively.

8.1 How to Perform a Manual Search of HEP Summary Aggregations

The steps contained in this section reflect the task flow in Figure 3 and are illuminated by use of an example of a manual search of aggregated HEP data.

One begins the summary aggregation search process by establishing HEP data requirements (see Step 1.0). For purposes of illustration, the problem being researched is:

> A user is performing a risk analysis that must reflect the contribution of errors related to feedwater systems to core melt frequency. The analyst will want to use an HRA technique to establish this value. In almost all cases, HRA techniques require error probabilities that are weighted or transformed to reflect environmental or task influences on individual or crew behavior. In an effort to obtain a base HEP that can be tailored to the risk analysis requirements, the user refers to the NUCLARR series of reports and makes use of Part 4: Summary Aggregations.
>
> For our hypothetical case, the analyst wishes to determine the probability that a control room operator at a Westinghouse plant will fail to operate a feedwater system properly.

We could have more specifics listed, such as the specific plant, adequacy of training at that plant, stress available, and ongoing plant

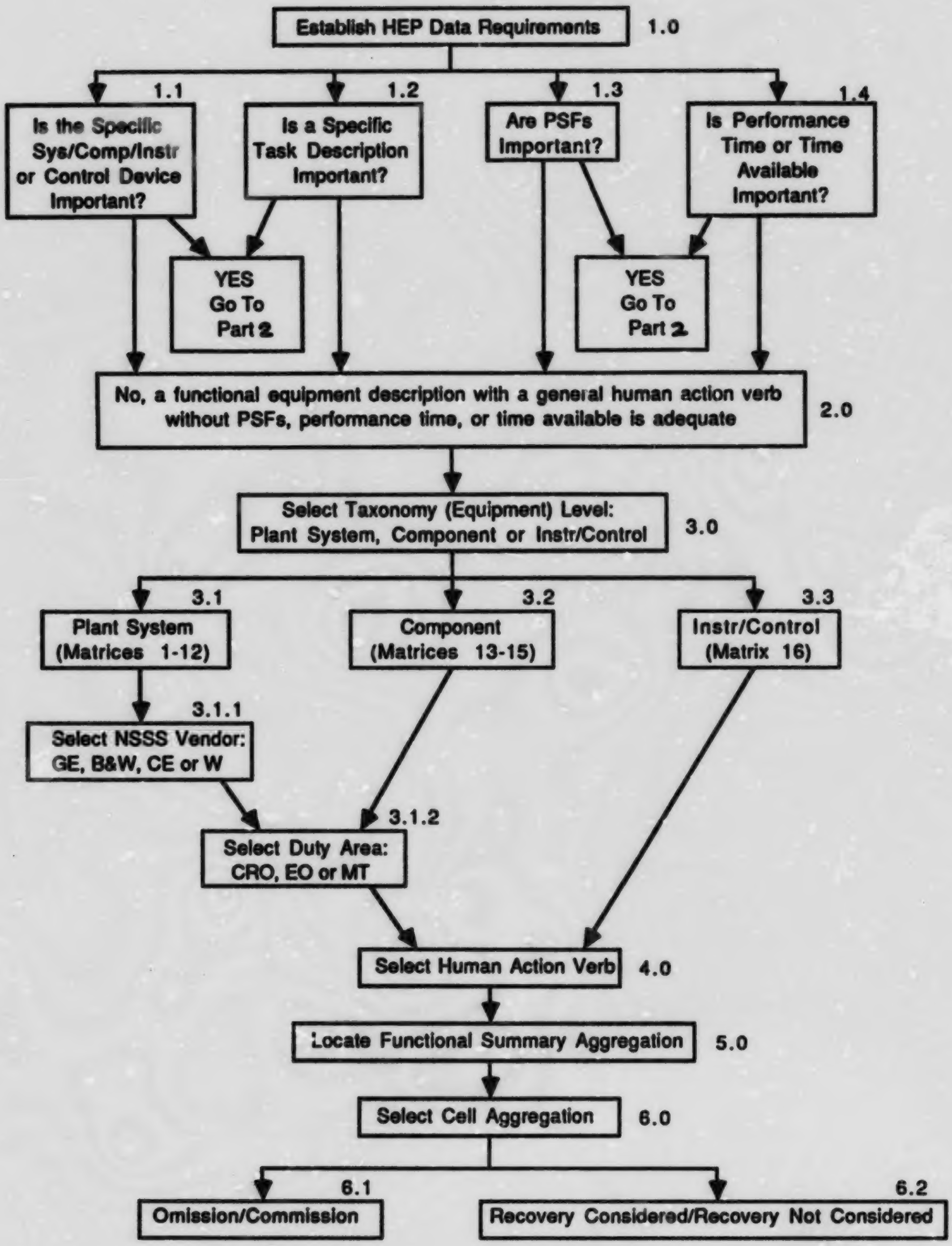
Establish HEP Data Requirements
1.0
1.1
Is the Specific Sys/Comp/Instr or Control Device Important?
1.2
Is a Specific Task Description Important?
1.3
Are PSFs Important?
1.4
Is Performance Time or Time Available Important?
YES Go To Part 2
YES Go To Part 2
No, a functional equipment description with a general human action verb without PSFs, performance time, or time available is adequate
2.0
Select Taxonomy (Equipment) Level: Plant System, Component or Instr/Control
3.0
3.1
Plant System (Matrices 1-12)
3.2
Component (Matrices 13-15)
3.3
Instr/Control (Matrix 16)
3.1.1
Select NSSS Vendor: GE, B&W, CE or W
3.1.2
Select Duty Area: CRO, EO or MT
Select Human Action Verb
4.0
Locate Functional Summary Aggregation
5.0
Select Cell Aggregation
6.0
6.1
Omission/Commission
6.2
Recovery Considered/Recovery Not Considered

Figure 3. Top level flow for manual search of aggregated HEP data.

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conditions. Steps 1.1 through 1.4 aid us in determining the degree of resolution allowed in this report.

Figure 3, Step 1.1 requires the analyst to assess whether or not the analysis calls for HEP estimates related to plant-specific equipment. For example, if the user needed data peculiar to a particular piece of equipment at the Yankee Rowe plant, then Part 2 of this series should be consulted. The summary aggregations in Part 4 allow for designation of NSSS vendor but not individual plant.

Likewise, Step 1.2 calls for the user to decide if a specific task description is important. For example, if the user needs to know if the operator error was related to trying to shut the feedwater motor operated valves during a loss-of offsite power, then Part 2, page A-186, should be consulted. Part 4 presents summary data with functional descriptions, action verbs, and NSSS vendor (for Level 1). Recovery and error type factors are also represented.

Step 1.3 requires the NUCLARR user to decide whether or not PSFs are of importance in his or her analysis. PSFs are factors which affect human performance and may be aspects of the person, aspects of the environment, nature of the task, time available, and the quality of supervision and procedures. If PSFs are important, Part 2 of this series should be consulted. NUCLARR Volume IV, Part 3, presents definitions and rating criteria for the PSFs coded in the NUCLARR data management system.

Step 1.4 is related to both the time available for an operator or crew to respond and the time usually required for the crew to respond. Often these data can be useful in shaping a particular HEP or in determining a non-response probability. Once again, if this type of detailed information is necessary then the analyst should leave this report and refer to Part 2.

If the answers to the HEP data requirements as outlined in steps 1.1 through 1.4 are no, then the user may proceed to Step 2.0 and begin a search of summary aggregation data.

Step 3.0 helps to focus the search strategy by requiring the user to select an equipment taxonomy level used to code the human error rates in the NUCLARR system. Three choices are available to the user and correspond to Steps 3.1 through 3.3 of the task flow presented in Figure 3. Step 3.1 suggests a review of equipment coded by plant system. Examples of this category would be chemical volume and control systems, condensate systems, instrument air systems, and electrical distribution systems. The equipment/personnel relationship is given in Table 4.

TABLE 4. NUCLARR EQUIPMENT/PERSONNEL MATRIX RELATIONSHIP

	Plant Position		
	CRO	AO/EO	MT
Level 1			
NSSS vendor:			
B&W	1	2	3
CE	4	5	6
GE	7	8	9
W	10	11	12
Level 2	13	14	15
Level 3			16

Step 3.2, selection of a component matrix, is only performed if an error rate related to personnel interfacing with valves, pumps, batteries, electric heaters, boilers, and the like is required. Matrices 13 through 15 in the NUCLARR taxonomy correspond to error rates related to personnel interfacing with plant components.

Step 3.3 requires users interested in error rates of plant personnel using or maintaining individual displays, indicators, or instruments and controls to limit their summary aggregation search to those data contained in matrix 16 of the NUCLARR taxonomy. Items to be found in this matrix include digital meters, stroboscopes, switches, etc.

In our analyst's problem, we are researching feedwater systems; we would select Matrix #4 (Step 3.1). We would also select Westinghouse as the NSSS vendor, thus satisfying Step 3.1.1.

Step 3.1.2, select duty area, would, in our example, be satisfied by selecting the control room operator. Other personnel that could be referenced include the auxiliary operator, equipment operator, and maintenance technician. Crew size is also tracked in the NUCLARR system, but not for the summary aggregation. The interested reader can locate crew complement and crew size information in Part 2 of the Data Manual.

Step 4.0 requires that the NUCLARR user select a human action verb. Action verbs are keyed to the levels of the NUCLARR taxonomy. Verbs corresponding to tasks related to instruments and controls are similar to but not exactly the same as verbs corresponding to the component and plant systems level of the taxonomy. Human action verbs are always contained in the columns of the two-dimensional matrix, and equipment is located in the rows.

For our example, go to matrix 4 and review the human action verbs available. Of the verbs available, operates is closest in meaning to the situations we wish to review. If a task contained the verb align, this would also be contained within the operates category. The code for identifying the functional summary aggregation for feedwater systems is to be determined from this page, as follows.

The matrix number determined in Step 3.1 is 04, feedwater systems code is 110, and our code for the human action verb operates is 01. In locating our functional summary aggregations, (Step 5.0), we turn to Appendix A of this report and look for those pages containing the code 0411001. Use the matrix code at the upper right hand of the page to aid you in your search. The functional summary aggregation HEP value is 4.0E-4, UCB = 0.001 and LCB = 0.00016.

The summary HEP on that page will represent the aggregation of those probabilities and associated confidence bounds catalogued in the NUCLARR system where the CRO at Westinghouse plants made an error while attempting to operate the feedwater system. The summary nature of the aggregation precludes the user from being able to determine if these HEP data came from operations, simulator training, consensus expert judgment, or laboratory data. If this level of detail is important, then the user should refer to Part 2.

Step 6.0 specifies that the user select cell aggregations. The cell aggregations are summaries of task statement HEPs and are, in turn, aggregated to form the functional summary aggregation. In our present example, there are two cell aggregations of interest; 0411101, relating to equipment class feedwater systems, and 0411201, relating to auxiliary feedwater systems. Find these in Appendix A as well. Their values are 2.99E-004 and 7.55E-004, respectively. Readers wanting to know if any of the values used in the aggregations represented such situations as "...failing to manually start aux feed during an anticipated transient without scram (ATWS) sequence" should refer to Part 2.

If enough data are present in NUCLARR, then there will be four cell summary pages for each aggregated value for the combination of equipment and human action verb. These four pages represent the combination of recovery and error type factors. Errors of omission and commission are determined for instances when crew recovery factors were and were not considered.

In our present case, we only have data for instances of omission where recovery factors have been considered. This will often be the case, due to the fact that errors of commission are less well represented in the NUCLARR system.

8.2 How to Perform a Manual Search of HCFD Summary Aggregations

The steps contained in this section reflect the task flow in Figure 4 and are illuminated by use of an example of a manual search of aggregated HEP data. All the necessary codes and summary data are located within this report.

By definition, the HCFD summary aggregations presented are limited in the amount of detail that they present. Readers desiring detail relating to the survey period, plant name, component design and severity of failure are requested to refer to Part 3 of the Data Manual.

Step 1.0 calls for the user to establish component failure rate data requirements. For illustrative purposes only, we will assume the following:

> An analyst is requested to determine failure rates for the conceptual design of a new plant. The analyst has no information regarding specific component design. The first component whose failure rate the analyst will attempt to determine is a motor-driven pump. To aid in this search, the analyst turns to the NUCLARR system. As in the previous example, the analyst has no computer resources available and instead will turn to this report.

Steps 1.1 through 1.3 represents aspects of the task flow where the analyst would have reason to exit this report and refer to Part 3 in search of increasing detail regarding the component(s) being researched. In our example, because the problem refers to the conceptual design of a plant, the specific design (Step 1.1), normal operating state (Step 1.2), and application or operating environment (Step 1.3) are undefined. The analyst can proceed to step 2.0. Under other circumstances, design factors such as whether axial or/centrifugal motor-driven pump data are required, whether the pumps were normally running or normally in standby, or whether these pumps were to be used to pump fresh water, salt water, or corrosives would perhaps drive the analysis.

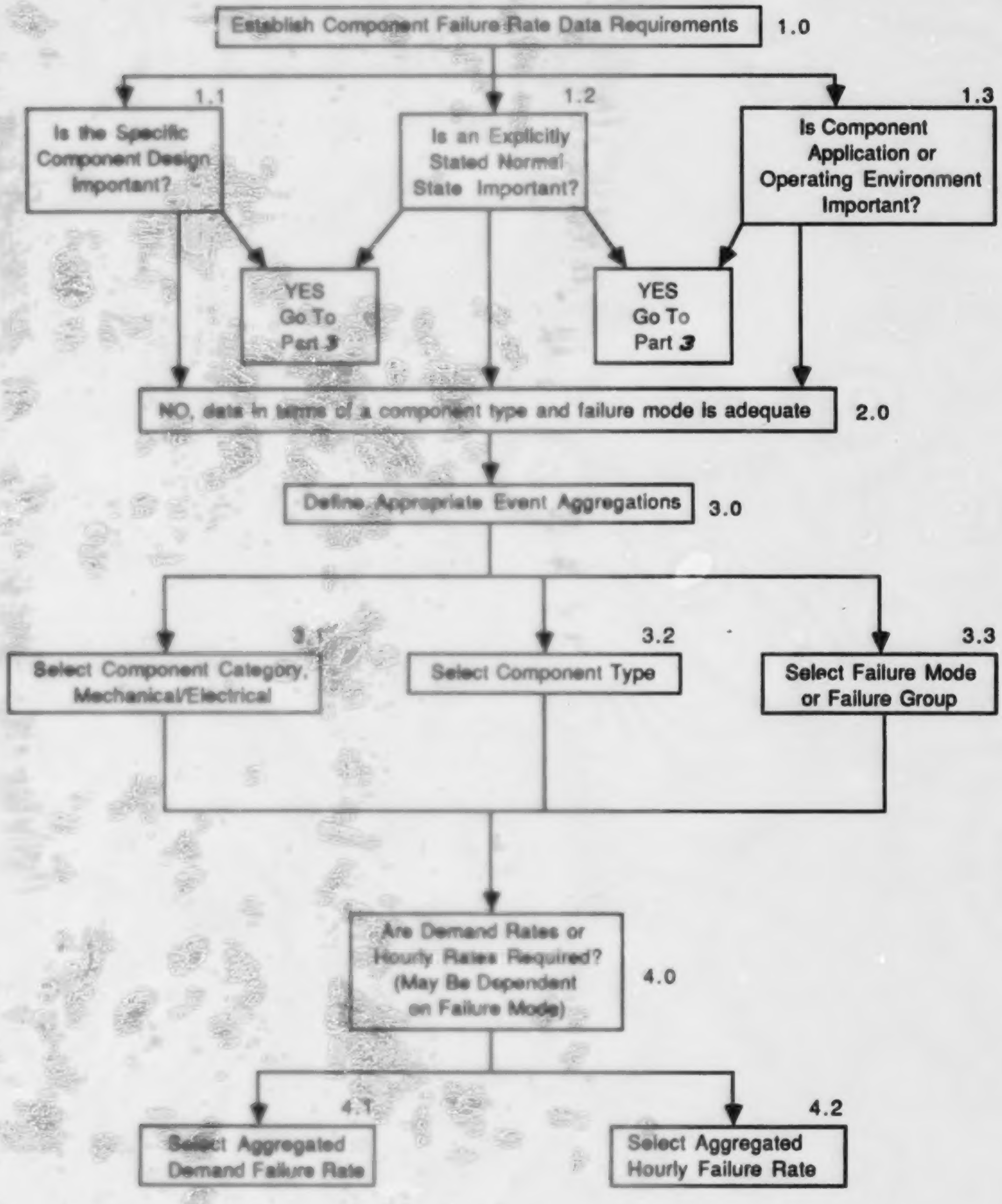
Establish Component Failure Rate Data Requirements
1.0
1.1
Is the Specific Component Design Important?
1.2
Is an Explicitly Stated Normal State Important?
1.3
Is Component Application or Operating Environment Important?
YES Go To Part 3
YES Go To Part 3
NO, data in terms of a component type and failure mode is adequate
2.0
Define Appropriate Event Aggregations
3.0
3.1
Select Component Category, Mechanical/Electrical
3.2
Select Component Type
3.3
Select Failure Mode or Failure Group
Are Demand Rates or Hourly Rates Required? (May Be Dependent on Failure Mode)
4.0
4.1
Select Aggregated Demand Failure Rate
4.2
Select Aggregated Hourly Failure Rate

Figure 4. Top level flow for manual search of aggregated HCFD.

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Step 2.0 requires that the analyst be satisfied with obtaining a summary aggregation for HCFD which can be defined in terms of a component type and failure mode. Our problem presents just such a situation.

The NUCLARR taxonomy classifies HCFD in terms of events where an event contains component and failure mode information. Step 3.0 instructs the analyst to define the appropriate event aggregation by carrying out Steps 3.1 through 3.3.

Step 3.1, select component category, requires the analyst to assign the component under review to the category of either electrical or mechanical components. In the present case, a motor-driven pump is assigned to the mechanical component category.

Step 3.2, select component type, directs the analyst to the NUCLARR component type codes (Appendix B) where the code PPM for motor-driven pumps is located.

Step 3.3, select failure mode or failure group, requires the analyst to select a code for one of the failure modes recognized by the NUCLARR system. These codes are listed in Table 5. Two are appropriate to motor-driven pumps. They are fails to run and fails to start.

Next (Step 4.0), the analyst determines what type of failure rate is required, hourly or demand. In many cases this will be dictated by the failure mode. For example, fails-to-run data, of which there are presently 62 data points in the NUCLARR system, are usually calculated per hour. Fails-to-start data, of which there are currently 58 records, are calculated on a per-demand basis. In our example, the analyst will follow Step 4.1 and determine the failure rate for motor-driven pumps that fail to start. Turn to page C-6 to find this rate. You should find a rate of 1.558E-003.

Step 4.2 requires the analyst to review hourly rates for motor driven pumps that fail to run. The corresponding error rate listed on page C-6 is

TABLE 5. HARDWARE FAILURE MODE CODES

Code	Description
FTG	FAILS TO OPERATE GROUP
FTO	Fails to Operate
FTS	Fails to Start
FTR	Fails to Run
FTP	Fails to Open
FTC	Fails to Close
FTE	Fails to Energize
FTD	Fails to Deenergize
FTT	Fails to Transfer Electrically
SOG	SPURIOUS OPERATION GROUP
SO	Spurious Operation
SS	Spurious Start
SP	Spurious Open (Transfer Open)
SC	Spurious Close (Transfer Close)
SE	Spurious Energize
SD	Spurious Deenergize
ST	Spurious Transfer electrically
LKG	LEAKAGE GROUP
LK	Leakage
EL	External Leakage/Rupture
IL	Internal Leakage
BLG	BLOCKAGE GROUP
BL	Blockage
PL	Plugged

1.128E-005. Notice that the NUCLARR system also provides an upper bound on the estimate and calculates the number of records entered and calculated in the aggregation. If a mean component failure rate for the distribution of rates is required, it can be computed based upon the relationship of the median estimate and the UCB. (Refer to Volume IV: User's Guide, Part 3, for this formula.)

This procedure (Steps 1.0 through 4.2) is repeated for each of the components identified in Step 1.0. For more information regarding the aggregation algorithms themselves, the reader is referred to Part 3 of Volume IV: User's Guide.

9. SUMMARY

The NUCLARR data management system is an NRC-sponsored respository for probabilistic data that is currently dedicated to human error probability and hardware component failure rates. This report provides the means for the analyst who is without access to computer resources to use the appended raw data in investigating risk-related issues.

Volume V: Data Manual, Parts 1 through 4, of NUREG/CR-4639 is an important source of rate-based information for the analyst and is a living document which will be updated on a periodic basis. These updates will be available to all users in the form of change pages which can be added to Parts 2 and 3 in the Volume V series. Part 4: Summary Aggregations will also be updated in its entirety to reflect any addition of HEP and HCFD rate-based data to the NUCLARR data management system.

The effort at the INEL involving the NUCLARR system is complementary to other NRC-sponsored efforts in the area of risk management, including the System Analysis and Risk Assessment (SARA)[12] and Integrated Reactor Reliability Assessment System (IRRAS)[13] programs.

Users of this volume which complements the computerized NUCLARR data management system are encouraged to submit HEP and/or HCFD directly to the NUCLARR Data Clearinghouse at the INEL. These data may be sent to the address specified in Section 1 of this report. Instructions regarding the appropriate formatting of these data may be found in EGG-REQ-7732, Specification for the Submission of Raw Human Error Probability Data to the NUCLARR Clearinghouse,[14] and EGG-REQ-7742, Requirements for Entry of Component Failure Data in the NUCLARR System.[8]

10. REFERENCES

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3. W. E. Gilmore, D. I. Gertman, B. G. Gilbert, and W. J. Galyean, Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR), Volume III: Data Base Management Guide for Processing Data and Revising the Data Manual, NUREG/CR-4639, EGG-2458 (to be published).

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14. D. I. Gertman, W. E. Gilmore, Specification for the Submission of Raw Human Error Probability Data to the NUCLARR Data Clearinghouse, EGG-REQ-7732, June 1987.

APPENDIX A

HUMAN ERROR PROBABILITY DATA SUMMARY AGGREGATIONS

Taxonomy Level: 1
Matrix: 1
Page Number: 0104001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONDENSATE SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0007500 UCB: .0075000 LCB: .0000750

Taxonomy Level: 1
Matrix: 1
Page Number: 0104101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Condensate Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered

Median: .0007500 UCB: .0075000 LCB: .0000750
Mean: .0019979 EF: 10

Taxonomy Level: 1
Matrix: 1 [illegible]

Page Number: 0105001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0005390 UCB: .0017495 LCB: .0001660

Taxonomy Level: 1
Matrix: 1

Page Number: 0105401

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Containment Penetration/Isolation System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0007500	UCB:	.0075000	LCB:	.0000750
	Mean:	.0019979	EF:	10		

Taxonomy Level: 1
Matrix: 1
Page Number: 0105501

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Containment Spray (RHR) System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0007500	UCB:	.0075000	LCB:	.0000750
	Mean:	.0019979	EF:	10		

```
Taxonomy Level: 1
Matrix:  1                                          Page Number: 0105701

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Suppression Pool Support System
NSSS Vendor/Equipment Level: General Electric
```

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0003873    UCB:  .0021229  LCB:  .0000707
                              Mean:  .0006251     EF:   5
```

Taxonomy Level: 1
Matrix: 1
Page Number: 0107001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONTROL ROD DRIVE SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0004743 UCB: .0024166 LCB: .0000931

Taxonomy Level: 1
Matrix: 1

Page Number: 0107101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Control Rod Drive Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0004743	UCB:	.0024166	LCB:	.0000931
	Mean:	.0007655	EF:	5		

Taxonomy Level: 1
Matrix: 1
Page Number: 0108001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF ELECTRICAL DISTRIBUTION SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0015000 UCB: .0150000 LCB: .0001500

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0600000 UCB: .6000000 LCB: .0060000

Taxonomy Level: 1
Matrix: 1
Page Number: 0108101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Electrical Distribution Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0015000    UCB:  .0150000  LCB:  .0001500
                              Mean:  .0039957     EF:  10
```

```
Omission Error:
  Recovery Not Considered   Median:  .0600000    UCB:  .6000000  LCB:  .0060000
                              Mean:  .1598300     EF:  10
```

Taxonomy Level: 1
Matrix: 1 Page Number: 0109001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0019234 UCB: .0048673 LCB: .0007600

Taxonomy Level: 1
Matrix: 1
Page Number: 0109002

Job Title: Control Room Operator
Human Action Verb: MONITORS
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0700000 UCB: .3100000 LCB: .0070000

Taxonomy Level: 1
Matrix: 1 Page Number: 0109601

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Coolant Injection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0060000	UCB:	.0300000	LCB:	.0002000
	Mean:	.0187806	EF:	12		

Taxonomy Level: 1
Matrix: 1

Job Title: Control Room Operator
Human Action Verb: MONITORS
Equipment Class: High Pressure Coolant Injection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0700000    UCB:  .3100000  LCB:  .0070000
                              Mean:  .1409260     EF:  7
```

Taxonomy Level: 1
Matrix: 1 Page Number: 0109701

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0400000	UCB:	.3000000	LCB:	.0050000
	Mean:	.0889388	EF:	8		

Taxonomy Level: 1
Matrix: 1 Page Number: 0109801

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Low Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0007500    UCB:  .0038209  LCB:  .0001472
                             Mean:  .0012104     EF:   5
```

Taxonomy Level: 1
Matrix: 1
Page Number: 0109901

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Residual Heat Removal/Low Pressure Coolant Injection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0006124	UCB:	.0029675	LCB:	.0001264
	Mean:	.0009884	EF:	5		

Taxonomy Level: 1
Matrix: 1
Page Number: 0113001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF GENERATOR SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0200000 UCB: .1018912 LCB: .0039258

Taxonomy Level: 1
Matrix: 1 Page Number: 0113301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Generator H2 Cooling/CO2 Purge System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0200000	UCB:	.1018912	LCB:	.0039258
	Mean:	.0322786	EF:	5		

Taxonomy Level: 1
Matrix: 1
Page Number: 0114001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF HEATING, VENTILATION & AIR CONDITIONING SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0346410 UCB: .1544248 LCB: .0077708

```
Taxonomy Level: 1
Matrix:  1                                        Page Number: 0114101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Heating, Ventilation & Air Conditioning Systems
NSSS Vendor/Equipment Level: General Electric
_______________________________________________________________________________

     Cell HEPs  (combined from Task HEPs)
_______________________________________________________________________________

Omission Error:
  Recovery Considered         Median:  .0346410    UCB:  .1544248  LCB:  .0077708
                                Mean:  .0494113     EF:   4
_______________________________________________________________________________
```

Taxonomy Level: 1
Matrix: 1 Page Number: 0115001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF INSTRUMENTATION AND CONTROL SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0006608 UCB: .0018163 LCB: .0002404

063

Taxonomy Level: 1
Matrix: 1
Page Number: 0116101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Protection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0002000    UCB:  .0010000  LCB:  .0000300
                              Mean:  .0003620     EF:  6
```

064

Taxonomy Level: 1
Matrix: 1
Page Number: 0116901

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Neutron Monitoring System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0008000	UCB:	.0090000	LCB:	.0000700
	Mean:	.0023150	EF:	11		

Taxonomy Level: 1
Matrix: 1
Page Number: 0117901

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Automatic Depressurization System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered Median: .0009235 UCB: .0035895 LCB: .0002376
Mean: .0013173 EF: 4

Taxonomy Level: 1
Matrix: 1
Page Number: 0123001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0049756 UCB: .0127378 LCB: .0019436

Taxonomy Level: 1
Matrix: 1 Page Number: 0123003

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0014142 UCB: .0100965 LCB: .0001981

Taxonomy Level: 1
Matrix: 1
Page Number: 0123101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Water Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered Median: .0072645 UCB: .0203431 LCB: .0025941
Mean: .0090797 EF: 3

Taxonomy Level: 1
Matrix: 1
Page Number: 0123203

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: Circulating Water System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0014142	UCB:	.0100965	LCB:	.0001981
	Mean:	.0028471	EF:	7		

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Station Service Water System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0007500	UCB:	.0075000	LCB:	.0000750
	Mean:	.0019979	EF:	10		

Taxonomy Level: 1
Matrix: 1
Page Number: 0125001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF REACTOR COOLANT SYSTEMS & CONNECTED SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP:	.0042028	UCB:	.0126905	LCB:	.0013919
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP:	.0010000	UCB:	.0060000	LCB:	.0002000

Taxonomy Level: 1
Matrix: 1
Page Number: 0125101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Coolant Systems and Connected Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered   Median: .0026000   UCB: .0260000   LCB: .0002600
Mean: .0069260   EF: 10

Taxonomy Level: 1
Matrix: 1
Page Number: 0125401

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Core Isolation Cooling System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0346410	UCB:	.1544248	LCB:	.0077708
	Mean:	.0494113	EF:	4		
Commission Error:						
Recovery Considered	Median:	.0010000	UCB:	.0060000	LCB:	.0002000
	Mean:	.0016139	EF:	5		

074

Taxonomy Level: 1
Matrix: 1

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Standby Liquid Control System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0001000    UCB:  .0020000  LCB:  .0000200
                              Mean:  .0002664     EF:  10
```

Taxonomy Level: 1
Matrix: 2

Page Number: 0200011

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF AIR SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0007500 UCB: .0075000 LCB: .0000750

Taxonomy Level: 1
Matrix: 2 Page Number: 0200211

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Instrument Air System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0007500    UCB:  .0075000  LCB:  .0000750
                              Mean:  .0019979     EF:  10
```

Taxonomy Level: 1
Matrix: 2 Page Number: 0208011

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF ELECTRICAL DISTRIBUTION SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0516038 UCB: .1008135 LCB: .0264146

Taxonomy Level: 1
Matrix: 2 Page Number: 0208013

Job Title: Equipment Operator
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF ELECTRICAL DISTRIBUTION SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0625827 UCB: .1290869 LCB: .0303407

Taxonomy Level: 1
Matrix: 2 Page Number: 0208111

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Electrical Distribution Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0193752    UCB:  .0487878  LCB:  .0076945
                              Mean:  .0242165     EF:    3
```

080

Taxonomy Level: 1
Matrix: 2 Page Number: 0208113

Job Title: Equipment Operator
Human Action Verb: MAINTAINS
Equipment Class: Electrical Distribution Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0625827    UCB:  .1290869  LCB:  .0303407
                             Mean:  .0683933     EF:   2
```

Taxonomy Level: 1
Matrix: 2

Page Number: 0208311

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: DC Power System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.2243023	UCB:	.5743525	LCB:	.0875970
	Mean:	.2803484	EF:	3		

Taxonomy Level: 1
Matrix: 2
Page Number: 0209011

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0015000	UCB: .0056682	LCB: .0003970
ERRORS OF OMISSION RECOVERY NOT CONSIDERED	HEP: .0300000	UCB: .3900000	LCB: .0050000

Taxonomy Level: 1
Matrix: 2
Page Number: 0209611

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Coolant Injection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Not Considered   Median:  .0300000   UCB:  .3900000  LCB:  .0050000
                              Mean:  .0732114    EF:   9
```

Taxonomy Level: 1
Matrix: 2
Page Number: 0209711

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0015000	UCB:	.0150000	LCB:	.0001500
	Mean:	.0039957	EF:	10		

Taxonomy Level: 1
Matrix: 2
Page Number: 0209811

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Low Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0015000 UCB: .0150000 LCB: .0001500
Mean: .0039957 EF: 10

Taxonomy Level: 1
Matrix: 2
Page Number: 0209911

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Residual Heat Removal/Low Pressure Coolant Injection System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered Median: .0015000 UCB: .0150000 LCB: .0001500
Mean: .0039957 EF: 10

Taxonomy Level: 1
Matrix: 2 Page Number: 0225011

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF REACTOR COOLANT SYSTEMS & CONNECTED SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0015000 UCB: .0150000 LCB: .0001500

Taxonomy Level: 1
Matrix: 2

Page Number: 0225411

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Core Isolation Cooling System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0015000    UCB:  .0150000  LCB:  .0001500
                              Mean:  .0039957     EF:  10
```

Taxonomy Level: 1
Matrix: 2 Page Number: 0227013

Job Title: Equipment Operator
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF STEAM SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0133276 UCB: .0343620 LCB: .0051692

Taxonomy Level: 1
Matrix: 2
Page Number: 0227313

Job Title: Equipment Operator
Human Action Verb: MAINTAINS
Equipment Class: Main Steam System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0133276
UCB: .0343620
LCB: .0051692
Mean: .0166578
EF: 3

Taxonomy Level: 1
Matrix: 3

Page Number: 0305020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0030000 UCB: .0300000 LCB: .0003000

Taxonomy Level: 1
Matrix: 3
Page Number: 0305720

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Suppression Pool Support System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0030000    UCB:  .0300000  LCB:  .0003000
                             Mean:  .0079915     EF:  10
```

Taxonomy Level: 1
Matrix: 3 Page Number: 0307020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF CONTROL ROD DRIVE SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED MEP: .0030000 UCB: .0300000 LCB: .0003000

Taxonomy Level: 1
Matrix: 3
Page Number: 0307120

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Control Rod Drive Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0030000    UCB:  .0300000  LCB:  .0003000
                             Mean:  .0079915     EF:  10
```

095

Taxonomy Level: 1
Matrix: 3
Page Number: 0309023

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0482315 UCB: .1622500 LCB: .0143376

Taxonomy Level: 1
Matrix: 3
Page Number: 0309723

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: High Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .1933908    UCB:  .7914718  LCB:  .0472537
                              Mean:  .2758494     EF:   4
```

097

Taxonomy Level: 1
Matrix: 3

Page Number: 0309823

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Low Pressure Core Spray System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered

Median:	.0030000	UCB:	.0300000	LCB:	.0003000
Mean:	.0079915	EF:	10		

Taxonomy Level: 1
Matrix: 3

Page Number: 0315020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF INSTRUMENTATION AND CONTROL SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0003000 UCB: .0030000 LCB: .0000300

Taxonomy Level: 1
Matrix: 3

Page Number: 0315023

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF INSTRUMENTATION AND CONTROL SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0001000 UCB: .0010000 LCB: .0000100

Taxonomy Level: 1
Matrix: 3 Page Number: 0315120

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Instrumentation and Control Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Considered      Median:  .0003000   UCB:  .0030000  LCB:  .0000300
                             Mean:  .0007991    EF:  10
```

Taxonomy Level: 1
Matrix: 3 Page Number: 0315123

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Instrumentation and Control Systems
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered Median: .0001000 UCB: .0010000 LCB: .0000100
Mean: .0002664 EF: 10

Taxonomy Level: 1
Matrix: 3

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0010000 UCB: .0100000 LCB: .0001000

Taxonomy Level: 1
Matrix: 3

Page Number: 0324123

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Station Service Water System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Not Considered   Median:  .0010000    UCB:  .0100000  LCB:  .0001000
                              Mean:  .0026638     EF:  10
```

Taxonomy Level: 1
Matrix: 3
Page Number: 0325020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF REACTOR COOLANT SYSTEMS & CONNECTED SYSTEMS
NSSS Vendor/Equipment Level: General Electric

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0022467 UCB: .0074203 LCB: .0006802

Taxonomy Level: 1
Matrix: 3
Page Number: 0325720

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Standby Liquid Control System
NSSS Vendor/Equipment Level: General Electric

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.0022467	UCB:	.0074203	LCB:	.0006802
	Mean:	.0028081	EF:	3		

Taxonomy Level: 1
Matrix: 4

Page Number: 0404001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONDENSATE SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: 1.0000000 UCB: 1.0000000 LCB: 1.0000000

Taxonomy Level: 1
Matrix: 4

Page Number: 0404101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Condensate Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered

Median: 1.0000000 UCB: 1.0000000 LCB: 1.0000000
Mean: 1.0000000 EF: 1

Taxonomy Level: 1
Matrix: 4 Page Number: 0405001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0004900 UCB: .0049000 LCB: .0000490

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0003338 UCB: .0012614 LCB: .0000883

Taxonomy Level: 1
Matrix: 4

Page Number: 0406301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Containment Isolation System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0000310	UCB:	.0003100	LCB:	.0000031
	Mean:	.0000826	EF:	10		

Taxonomy Level: 1
Matrix: 4

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Containment Spray System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0004900	UCB:	.0049000	LCB:	.0000490
	Mean:	.0013053	EF:	10		
Omission Error:						
Recovery Not Considered	Median:	.0010954	UCB:	.0055808	LCB:	.0002150
	Mean:	.0017679	EF:	5		

Taxonomy Level: 1
Matrix: 4

Page Number: 0409000

Job Title: Control Room Operator
Human Action Verb: TESTS
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0001600 UCB: .0016000 LCB: .0000160

112

Taxonomy Level: 1
Matrix: 4
Page Number: 0409001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0009519 UCB: .0017251 LCB: .0005253

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0031931 UCB: .0100973 LCB: .0010097

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0027928 UCB: .0142283 LCB: .0005482

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0003000 UCB: .0030000 LCB: .0000300

113

Taxonomy Level: 1
Matrix: 4

Page Number: 0409003

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0030000 UCB: .0300000 LCB: .0003000

Taxonomy Level: 1
Matrix: 4
Page Number: 0409100

Job Title: Control Room Operator
Human Action Verb: TESTS
Equipment Class: Emergency Core Cooling Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered Median: .0001600 UCB: .0016000 LCB: .0000160
Mean: .0004262 EF: 10

Taxonomy Level: 1
Matrix: 4

Page Number: 0409101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Emergency Core Cooling Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered — Median: .0021213 — UCB: .0108072 — LCB: .0004164
Mean: .0034236 — EF: 5

Omission Error:
Recovery Not Considered — Median: .0031464 — UCB: .0160297 — LCB: .0006176
Mean: .0050781 — EF: 5

Taxonomy Level: 1
Matrix: 4
Page Number: 0409201

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Safety Injection System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0016433 UCB: .0032901 LCB: .0008207
Mean: .0017959 EF: 2

Omission Error:
Recovery Not Considered
Median: .0035000 UCB: .0350000 LCB: .0003500
Mean: .0093234 EF: 10

Commission Error:
Recovery Considered
Median: .0027928 UCB: .0142283 LCB: .0005482
Mean: .0045074 EF: 5

Commission Error:
Recovery Not Considered
Median: .0003000 UCB: .0030000 LCB: .0000300
Mean: .0007991 EF: 10

Taxonomy Level: 1
Matrix: 4

Page Number: 0409301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Residual Heat Removal/Low Pressure Safety Injection System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.0000212	UCB:	.0001081	LCB:	.0000042
	Mean:	.0000342	EF:	5		
Omission Error: Recovery Not Considered	Median:	.0030000	UCB:	.0300000	LCB:	.0003000
	Mean:	.0079915	EF:	10		

Taxonomy Level: 1
Matrix: 4 Page Number: 0409303

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: Residual Heat Removal/Low Pressure Safety Injection System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Not Considered Median: .0030000 UCB: .0300000 LCB: .0003000
Mean: .0079915 EF: 10

Taxonomy Level: 1
Matrix: 4 Page Number: 0411001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF FEEDWATER SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0004077 UCB: .0010434 LCB: .0001593

Taxonomy Level: 1
Matrix: 4

Page Number: 0411003

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: SUMMARY OF FEEDWATER SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0110000 UCB: .1100000 LCB: .0011000

Taxonomy Level: 1
Matrix: 4

Page Number: 0411101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Feedwater Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median: .0002996		UCB: .0009468		LCB: .0000948	
	Mean: .0003745		EF: 3			

Taxonomy Level: 1
Matrix: 4
Page Number: 0411201

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Auxiliary Feedwater System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0007550	UCB:	.0038463	LCB:	.0001482
	Mean:	.0012185	EF:	5		

Taxonomy Level: 1
Matrix: 4

Page Number: 0411203

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: Auxiliary Feedwater System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0110000	UCB:	.1100000	LCB:	.0011000
	Mean:	.0293022	EF:	10		

Taxonomy Level: 1
Matrix: 4
Page Number: 0414003

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: SUMMARY OF HEATING, VENTILATION & AIR CONDITIONING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0006000 UCB: .0060000 LCB: .0000600

Taxonomy Level: 1
Matrix: 4
Page Number: 0414103

Job Title: Control Room Operator
Human Action Verb: DIAGNOSES
Equipment Class: Heating, Ventilation & Air Conditioning Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0006000	UCB:	.0060000	LCB:	.0000600
	Mean:	.0015983	EF:	10		

126

Taxonomy Level: 1
Matrix: 4

Page Number: 0415001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF INSTRUMENTATION AND CONTROL SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0079331 UCB: .0148422 LCB: .0042402

Taxonomy Level: 1
Matrix: 4
Page Number: 0415301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Engineered Safeguards Actuation and Logic System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered        Median:  .0375489    UCB:  .1103727  LCB:  .0127742
                               Mean:  .0469312     EF:   3
```

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```
Taxonomy Level: 1
Matrix:  4                                           Page Number: 0415701

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Pressurizer Level Control System
NSSS Vendor/Equipment Level: Westinghouse
```

```
     Cell HEPs  (combined from Task HEPs)
```

```
Omission Error:
  Recovery Considered       Median:  .0117004    UCB:  .0596085  LCB:  .0022967
                              Mean:  .0188837     EF:   5
```

Taxonomy Level: 1
Matrix: 4
Page Number: 0415801

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Pressurizer Pressure Control System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0065347	UCB:	.0182995	LCB:	.0023335
	Mean:	.0081675	EF:	3		

Taxonomy Level: 1
Matrix: 4
Page Number: 0416101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Protection System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered

Median: .0003899 UCB: .0019862 LCB: .0000765
Mean: .0006293 EF: 5

Taxonomy Level: 1
Matrix: 4 Page Number: 0420001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF REACTOR COOLANT SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0029240 UCB: .0148967 LCB: .0005740

Taxonomy Level: 1
Matrix: 4
Page Number: 0420301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Chemical And Volume Control System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered        Median:  .0029240    UCB:  .0148967  LCB:  .0005740
                               Mean:  .0047191     EF:  5
```

Taxonomy Level: 1
Matrix: 4
Page Number: 0421001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF REFUELING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0001900 UCB: .0019000 LCB: .0000190

```
Taxonomy Level: 1
Matrix: 4                                          Page Number: 0421301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Spent Fuel Pit Cooling System
NSSS Vendor/Equipment Level: Westinghouse
```

```
    Cell HEPs  (combined from Task HEPs)
```

```
Omission Error:
 Recovery Considered       Median:  .0001900    UCB:  .0019000  LCB:  .0000190
                             Mean:  .0005061     EF:  10
```

Taxonomy Level: 1
Matrix: 4

Page Number: 0422001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF TURBINE SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0003800 UCB: .0038000 LCB: .0000380

Taxonomy Level: 1
Matrix: 4

Page Number: 0422101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Turbine Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0003800	UCB:	.0038000	LCB:	.0000380
	Mean:	.0010123	EF:	10		

Taxonomy Level: 1
Matrix: 4

Page Number: 0423001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED NEP: .0002687 UCB: .0013566 LCB: .0000532

Taxonomy Level: 1
Matrix: 4
Page Number: 0423301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Component Cooling Water System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0002687	UCB:	.0013566	LCB:	.0000532
	Mean:	.0004337	EF:	5		

Taxonomy Level: 1
Matrix: 4
Page Number: 0429001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF MAIN STEAM SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0015000 UCB: .0076418 LCB: .0002944

```
Taxonomy Level: 1
Matrix:  4                                        Page Number: 0429101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Main Steam System
NSSS Vendor/Equipment Level: Westinghouse
```

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Considered        Median:  .0015000    UCB:  .0076418  LCB:  .0002944
                               Mean:  .0024209     EF:   5
```

Taxonomy Level: 1
Matrix: 6 Page Number: 0605020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0010000 UCB: .0100000 LCB: .0001000

Taxonomy Level: 1
Matrix: 6
Page Number: 0605023

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0010000 UCB: .0100000 LCB: .0001000

Taxonomy Level: 1
Matrix: 6
Page Number: 0606420

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Containment Spray System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0010000	UCB:	.0100000	LCB:	.0001000
	Mean:	.0026638	EF:	10		

Taxonomy Level: 1
Matrix: 6
Page Number: 0606423

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Containment Spray System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Not Considered	Median:	.0010000	UCB:	.0100000	LCB:	.0001000
	Mean:	.0026638	EF:	10		

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0000110 UCB: .0001100 LCB: .0000011

Taxonomy Level: 1
Matrix: 6

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0000193 UCB: .0001007 LCB: .0000037

Taxonomy Level: 1
Matrix: 6 Page Number: 0609123

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Emergency Core Cooling Systems
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0000193    UCB:  .0001007  LCB:   .0000037
                              Mean:  .0000311     EF:    5
```

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Taxonomy Level: 1
Matrix: 6

Page Number: 0609320

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Residual Heat Removal/Low Pressure Safety Injection System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0000110	UCB:	.0001100	LCB:	.0000011
	Mean:	.0000293	EF:	10		

Taxonomy Level: 1
Matrix: 6
Page Number: 0615023

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF INSTRUMENTATION AND CONTROL SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0000490	UCB: .0004900	LCB: .0000049
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP: .0012000	UCB: .0120000	LCB: .0001200

```
Taxonomy Level: 1
Matrix:  6                                          Page Number: 0615323

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Engineered Safeguards Actuation and Logic System
NSSS Vendor/Equipment Level: Westinghouse
________________________________________________________________________________

     Cell HEPs  (combined from Task HEPs)
________________________________________________________________________________

Omission Error:
  Recovery Considered      Median:  .0000490    UCB:  .0004900  LCB:  .0000049
                             Mean:  .0001305     EF:  10
________________________________________________________________________________

Commission Error:
  Recovery Considered      Median:  .0012000    UCB:  .0120000  LCB:  .0001200
                             Mean:  .0031966     EF:  10
________________________________________________________________________________
```

Taxonomy Level: 1
Matrix: 6

Page Number: 0623020

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: Westinghouse

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0000501 UCB: .0001891 LCB: .0000132

Taxonomy Level: 1
Matrix: 6
Page Number: 0623320

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Component Cooling Water System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered   Median: .0000380   UCB: .0003800   LCB: .0000038
Mean: .0001012   EF: 10

Taxonomy Level: 1
Matrix: 6
Page Number: 0623520

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Nuclear Service Water System
NSSS Vendor/Equipment Level: Westinghouse

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0000574	UCB:	.0002927	LCB:	.0000113
	Mean:	.0000926	EF:	5		

Taxonomy Level: 1
Matrix: 10
Page Number: 1000001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF AIR SYSTEMS
NSSS Vendor/Equipment Level: Babcock & Wilcox

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0192873 UCB: .0982603 LCB: .0037859

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .3000000 UCB: .9000000 LCB: .1000000

Taxonomy Level: 1
Matrix: 10 Page Number: 1000101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Air Systems
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0192873	UCB:	.0982603	LCB:	.0037859
	Mean:	.0311284	EF:	5		

Taxonomy Level: 1
Matrix: 10

Page Number: 1000201

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Instrument Air System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Considered Median: .3000000 UCB: .9000000 LCB: .1000000
Mean: .3749606 EF: 3

Taxonomy Level: 1
Matrix: 10
Page Number: 1005001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF CONTAINMENT SYSTEMS
NSSS Vendor/Equipment Level: Babcock & Wilcox

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .5000000 UCB: .5000000 LCB: .5000000

Taxonomy Level: 1
Matrix: 10

Page Number: 1006801

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Reactor Building Spray System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median: .5000000	UCB: .5000000	LCB: .5000000
	Mean: .5000000	EF: 1	

Taxonomy Level: 1
Matrix: 10
Page Number: 1009001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF EMERGENCY CORE COOLING SYSTEMS
NSSS Vendor/Equipment Level: Babcock & Wilcox

ERRORS OF OMISSION
RECOVERY CONSIDERED NEP: .0254632 UCB: .0487770 LCB: .0132926

ERRORS OF COMMISSION
RECOVERY CONSIDERED NEP: .0500000 UCB: .5000000 LCB: .0050000

Taxonomy Level: 1
Matrix: 10   Page Number: 1009101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Emergency Core Cooling Systems
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .5000000    UCB:  .5000000  LCB:  .5000000
                              Mean:  .5000000     EF:  1
```

Taxonomy Level: 1
Matrix: 10

Page Number: 1009201

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: High Pressure Safety Injection System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.0226793	UCB:	.0584595	LCB:	.0087984
	Mean:	.0283461	EF:	3		
Commission Error: Recovery Considered	Median:	.0500000	UCB:	.5000000	LCB:	.0050000
	Mean:	.1331916	EF:	10		

Taxonomy Level: 1
Matrix: 10

Page Number: 1009301

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Decay Heat Removal/Core Flooding System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .1000000    UCB:  .3000000  LCB:  .0333333
                              Mean:  .1249869     EF:  3
```

Taxonomy Level: 1
Matrix: 10 Page Number: 1009401

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Decay Heat Removal/Low Pressure Safety Injection System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0038730	UCB:	.0197312	LCB:	.0007602
	Mean:	.0062508	EF:	5		

Taxonomy Level: 1
Matrix: 10
Page Number: 1011001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF FEEDWATER SYSTEMS
NSSS Vendor/Equipment Level: Babcock & Wilcox

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0031623	UCB: .0161104	LCB: .0006207
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP: .1967980	UCB: .3166813	LCB: .1222991

```
Taxonomy Level: 1
Matrix: 10                                       Page Number: 1011101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Feedwater Systems
NSSS Vendor/Equipment Level: Babcock & Wilcox
________________________________________________________________________

     Cell HEPs  (combined from Task HEPs)
________________________________________________________________________
Omission Error:
  Recovery Considered       Median:  .0010000    UCB:  .0100000  LCB:  .0001000
                              Mean:  .0026638     EF:  10
________________________________________________________________________
Commission Error:
  Recovery Considered       Median:  .2466212    UCB:  .4139497  LCB:  .1469309
                              Mean:  .2695190     EF:   2
________________________________________________________________________
```

Taxonomy Level: 1
Matrix: 10
Page Number: 1011401

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Emergency Feedwater System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered — Median: .0100000 UCB: .1000000 LCB: .0010000
Mean: .0266383 EF: 10

Commission Error:
Recovery Considered — Median: .1000000 UCB: .3000000 LCB: .0333333
Mean: .1249869 EF: 3

Taxonomy Level: 1
Matrix: 10 Page Number: 1023001

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF WATER SYSTEMS
NSSS Vendor/Equipment Level: Babcock & Wilcox

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0036056 UCB: .0183687 LCB: .0007077

Taxonomy Level: 1
Matrix: 10

Page Number: 1023101

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Water Systems
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0010000    UCB:  .0100000  LCB:  .0001000
                             Mean:  .0026638     EF:  10
```

Taxonomy Level: 1
Matrix: 10
Page Number: 1023601

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Low Pressure Service Water System
NSSS Vendor/Equipment Level: Babcock & Wilcox

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0130000    UCB:  .1300000  LCB:  .0013000
                             Mean:  .0346298     EF:  10
```

Taxonomy Level: 2
Matrix: 13
Page Number: 1304034

Job Title: Control Room Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: SUMMARY OF CIRCUIT CLOSURES/INTERRUPTERS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0114471 UCB: .0359921 LCB: .0036407

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0050331 UCB: .0094907 LCB: .0026692

Taxonomy Level: 2
Matrix: 13
Page Number: 1304234

Job Title: Control Room Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: Circuit Breaker
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0316228	UCB:	.1132389	LCB:	.0088309
	Mean:	.0451062	EF:	4		
Commission Error:						
Recovery Not Considered	Median:	.0050331	UCB:	.0094907	LCB:	.0026692
	Mean:	.0055004	EF:	2		

Taxonomy Level: 2
Matrix: 13 **Page Number: 1304734**

Job Title: Control Room Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: Switchgear
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	**Median:**	**.0015000**	**UCB:**	**.0150000**	**LCB:**	**.0001500**
	Mean:	**.0039957**	**EF:**	**10**		

Taxonomy Level: 2
Matrix: 13

Page Number: 1322032

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF PUMPS
NSSS Vendor/Equipment Level: Components

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0052000 UCB: .0520000 LCB: .0005200

Taxonomy Level: 2
Matrix: 13

Page Number: 1322035

Job Title: Control Room Operator
Human Action Verb: STARTS/STOPS
Equipment Class: SUMMARY OF PUMPS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0003800 UCB: .0038000 LCB: .0000380

Taxonomy Level: 2
Matrix: 13
Page Number: 1322132

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Pumps
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Considered      Median:  .0052000   UCB:  .0520000  LCB:  .0005200
                             Mean:  .0138519    EF:  10
```

Taxonomy Level: 2
Matrix: 13 Page Number: 1322135

Job Title: Control Room Operator
Human Action Verb: STARTS/STOPS
Equipment Class: Pumps
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0003800   UCB:  .0038000  LCB:  .0000380
                             Mean:  .0010123    EF:  10
```

Taxonomy Level: 2
Matrix: 13
Page Number: 1328032

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF TURBINES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0100000 UCB: .0509456 LCB: .0019629

Taxonomy Level: 2
Matrix: 13   Page Number: 1328132

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Turbines
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered        Median:  .0100000    UCB:  .0509456  LCB:  .0019629
                               Mean:  .0161383     EF:   5
```

Taxonomy Level: 2
Matrix: 13
Page Number: 1329032

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0030000 UCB: .0300000 LCB: .0003000

Taxonomy Level: 2
Matrix: 13
Page Number: 1329132

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0300000	LCB:	.0003000
	Mean:	.0079915	EF:	10		

Taxonomy Level: 2
Matrix: 13 Page Number: 1331032

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF VALVE OPERATORS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0010410 UCB: .0039336 LCB: .0002755

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0015000 UCB: .0150000 LCB: .0001500

Taxonomy Level: 2
Matrix: 13 Page Number: 1331232

Job Title: Control Room Operator
Human Action Verb: OPERATES
Equipment Class: Electric Motor-AC
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0010410	UCB:	.0039336	LCB:	.0002755
	Mean:	.0014849	EF:	4		
Commission Error:						
Recovery Considered	Median:	.0015000	UCB:	.0150000	LCB:	.0001500
	Mean:	.0039957	EF:	10		

Taxonomy Level: 2
Matrix: 14
Page Number: 1404044

Job Title: Equipment Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: SUMMARY OF CIRCUIT CLOSURES/INTERRUPTERS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .1000000 UCB: .3000000 LCB: .0333333

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0030000 UCB: .0200000 LCB: .0002000

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0044224 UCB: .0076598 LCB: .0025533

```
Taxonomy Level: 2
Matrix: 14                                              Page Number: 1404244

Job Title: Equipment Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: Circuit Breaker
NSSS Vendor/Equipment Level: Components

-------------------------------------------------------------------------------
     Cell HEPs  (combined from Task HEPs)

-------------------------------------------------------------------------------
Omission Error:
  Recovery Considered        Median:  .1000000   UCB:  .3000000  LCB:  .0333333
                               Mean:  .1249869    EF:   3

-------------------------------------------------------------------------------
Commission Error:
  Recovery Considered        Median:  .0030000   UCB:  .0200000  LCB:  .0002000
                               Mean:  .0079915    EF:  10

-------------------------------------------------------------------------------
Commission Error:
  Recovery Not Considered    Median:  .0050331   UCB:  .0094907  LCB:  .0026692
                               Mean:  .0055004    EF:   2

-------------------------------------------------------------------------------
```

Taxonomy Level: 2
Matrix: 14 Page Number: 1404444

Job Title: Equipment Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: Disconnect
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0090000	LCB:	.0010000
	Mean:	.0037496	EF:	3		

Taxonomy Level: 2
Matrix: 14

Page Number: 1422041

Job Title: Equipment Operator
Human Action Verb: INSPECTS
Equipment Class: SUMMARY OF PUMPS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0015000	UCB: .0150000	LCB: .0001500

Taxonomy Level: 2
Matrix: 14

Page Number: 1422241

Job Title: Equipment Operator
Human Action Verb: INSPECTS
Equipment Class: Centrifugal Pump
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0015000 UCB: .0150000 LCB: .0001500
Mean: .0039957 EF: 10

Taxonomy Level: 2
Matrix: 14 Page Number: 1429041

Job Title: Equipment Operator
Human Action Verb: INSPECTS
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0030000 UCB: .0400000 LCB: .0002000

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Taxonomy Level: 2
Matrix: 14

Page Number: 1429042

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0300000 UCB: .3900000 LCB: .0050000

Taxonomy Level: 2
Matrix: 14
Page Number: 1429044

Job Title: Equipment Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .1000000 UCB: .3000000 LCB: .0333333

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0028284 UCB: .0143870 LCB: .0005561

Taxonomy Level: 2
Matrix: 14 Page Number: 1429141

Job Title: Equipment Operator
Human Action Verb: INSPECTS
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0030000    UCB:  .0400000  LCB:  .0002000
                             Mean:  .0108660     EF:  14
```

Taxonomy Level: 2
Matrix: 14
Page Number: 1429142

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered Median: .0300000 UCB: .3900000 LCB: .0050000
Mean: .0732114 EF: 9

Taxonomy Level: 2
Matrix: 14

Page Number: 1429144

Job Title: Equipment Operator
Human Action Verb: OPENS/CLOSES
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.1000000	UCB:	.3000000	LCB:	.0333333
	Mean:	.1249869	EF:	3		
Commission Error: Recovery Considered	Median:	.0028284	UCB:	.0143870	LCB:	.0005561
	Mean:	.0045648	EF:	5		

Taxonomy Level: 2
Matrix: 14

Page Number: 1431042

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: SUMMARY OF VALVE OPERATORS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0015000 UCB: .0150000 LCB: .0001500

Taxonomy Level: 2
Matrix: 14
Page Number: 1431242

Job Title: Equipment Operator
Human Action Verb: OPERATES
Equipment Class: Electric Motor-AC
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0015000	UCB:	.0150000	LCB:	.0001500
	Mean:	.0039957	EF:	10		

Taxonomy Level: 2
Matrix: 15 Page Number: 1504052

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF CIRCUIT CLOSURES/INTERRUPTERS
NSSS Vendor/Equipment Level: Components

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0044224 UCB: .0076598 LCB: .0025533

Taxonomy Level: 2
Matrix: 15 Page Number: 1504053

Job Title: Maintenance Technician
Human Action Verb: REPAIRS
Equipment Class: SUMMARY OF CIRCUIT CLOSURES/INTERRUPTERS
NSSS Vendor/Equipment Level: Components

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0044224 UCB: .0076598 LCB: .0025533

Taxonomy Level: 2
Matrix: 15
Page Number: 1504054

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF CIRCUIT CLOSURES/INTERRUPTERS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0007500 UCB: .0038209 LCB: .0001472

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0044224 UCB: .0076598 LCB: .0025533

Taxonomy Level: 2
Matrix: 15
Page Number: 1504252

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Circuit Breaker
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0050331 UCB: .0094907 LCB: .0026692
Mean: .0055004 EF: 2

Taxonomy Level: 2
Matrix: 15 Page Number: 1504253

Job Title: Maintenance Technician
Human Action Verb: REPAIRS
Equipment Class: Circuit Breaker
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0050331 UCB: .0094907 LCB: .0026692
Mean: .0055004 EF: 2

Taxonomy Level: 2
Matrix: 15 Page Number: 1504254

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Circuit Breaker
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0007500    UCB:  .0075000  LCB:  .0000750
                              Mean:  .0019979     EF:  10
```

```
Commission Error:
  Recovery Not Considered   Median:  .0050331    UCB:  .0094907  LCB:  .0026692
                              Mean:  .0055004     EF:   2
```

Taxonomy Level: 2
Matrix: 15
Page Number: 1504452

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Disconnect
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0030000 UCB: .0090000 LCB: .0010000
Mean: .0037496 EF: 3

Taxonomy Level: 2
Matrix: 15 Page Number: 1504453

Job Title: Maintenance Technician
Human Action Verb: REPAIRS
Equipment Class: Disconnect
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0090000	LCB:	.0010000
	Mean:	.0037496	EF:	3		

Taxonomy Level: 2
Matrix: 15
Page Number: 1504454

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Disconnect
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0090000	LCB:	.0010000
	Mean:	.0037496	EF:	3		

Taxonomy Level: 2
Matrix: 15
Page Number: 1504654

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Switch
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0007500	UCB:	.0075000	LCB:	.0000750
	Mean:	.0019979	EF:	10		

Taxonomy Level: 2
Matrix: 15
Page Number: 1506050

Job Title: Maintenance Technician
Human Action Verb: CALIBRATES
Equipment Class: SUMMARY OF CONTROL INSTRUMENTS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0001000	UCB: .0010000	LCB: .0000100

Taxonomy Level: 2
Matrix: 15 Page Number: 1506650

Job Title: Maintenance Technician
Human Action Verb: CALIBRATES
Equipment Class: Pressure Control Instrument
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0001000	UCB:	.0010000	LCB:	.0000100
	Mean:	.0002664	EF:	10		

Taxonomy Level: 2
Matrix: 15

Page Number: 1522052

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF PUMPS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .1933908 UCB: .7914718 LCB: .0472537

Taxonomy Level: 2
Matrix: 15

Page Number: 1522152

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Pumps
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .1933908    UCB:  .7914718  LCB:   .0472537
                              Mean:  .2758494     EF:   4
```

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Taxonomy Level: 2
Matrix: 15

Page Number: 1524050

Job Title: Maintenance Technician
Human Action Verb: CALIBRATES
Equipment Class: SUMMARY OF SENSORS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP:	.0000734	UCB:	.0003740	LCB:	.0000144
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP:	.0004762	UCB:	.0017995	LCB:	.0001260

Taxonomy Level: 2
Matrix: 15
Page Number: 1524850

Job Title: Maintenance Technician
Human Action Verb: CALIBRATES
Equipment Class: Level Sensor
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0001100 UCB: .0011000 LCB: .0000110
Mean: .0002939 EF: 10

Commission Error:
Recovery Considered
Median: .0003000 UCB: .0030000 LCB: .0000300
Mean: .0007991 EF: 10

Taxonomy Level: 2
Matrix: 15
Page Number: 1525150

Job Title: Maintenance Technician
Human Action Verb: CALIBRATES
Equipment Class: Pressure Sensor
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.0000490	UCB:	.0004900	LCB:	.0000049
	Mean:	.0001305	EF:	10		
Commission Error: Recovery Considered	Median:	.0006000	UCB:	.0030567	LCB:	.0001178
	Mean:	.0009684	EF:	5		

Taxonomy Level: 2
Matrix: 15
Page Number: 1529052

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0010000 UCB: .0100000 LCB: .0001000

Taxonomy Level: 2
Matrix: 15

Page Number: 1529054

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF VALVES
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0005876 UCB: .0012873 LCB: .0002683

Taxonomy Level: 2
Matrix: 15

Job Title: Maintenance Technician
Human Action Verb: MAINTAINS
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0010000	UCB:	.0100000	LCB:	.0001000
	Mean:	.0026638	EF:	10		

Taxonomy Level: 2
Matrix: 15 Page Number: 1529154

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Valves
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered       Median:  .0005876    UCB:  .0012873  LCB:  .0002683
                              Mean:  .0006422     EF:    2
```

Taxonomy Level: 2
Matrix: 15
Page Number: 1531054

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: SUMMARY OF VALVE OPERATORS
NSSS Vendor/Equipment Level: Components

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0000110 UCB: .0001100 LCB: .0000011

Taxonomy Level: 2
Matrix: 15
Page Number: 1531654

Job Title: Maintenance Technician
Human Action Verb: TESTS
Equipment Class: Pneumatic
NSSS Vendor/Equipment Level: Components

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0000110 UCB: .0001100 LCB: .0000011
Mean: .0000293 EF: 10

Taxonomy Level: 3
Matrix: 16 Page Number: 1600064

Job Title: Personnel
Human Action Verb: IDENTIFIES
Equipment Class: SUMMARY OF QUALITATIVE DISPLAYS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0029195 UCB: .0046714 LCB: .0018247

Taxonomy Level: 3
Matrix: 16
Page Number: 1600067

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: SUMMARY OF QUALITATIVE DISPLAYS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0306587 UCB: .0539172 LCB: .0174334

Taxonomy Level: 3
Matrix: 16 Page Number: 1600069

Job Title: Personnel
Human Action Verb: DIAGNOSES
Equipment Class: SUMMARY OF QUALITATIVE DISPLAYS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .5000000 UCB: .8162635 LCB: .3062737

Taxonomy Level: 3
Matrix: 16
Page Number: 1600264

Job Title: Personnel
Human Action Verb: IDENTIFIES
Equipment Class: Indicator Light
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0029195	UCB:	.0046714	LCB:	.0018247
	Mean:	.0031906	EF:	2		

Taxonomy Level: 3
Matrix: 16
Page Number: 1600569

Job Title: Personnel
Human Action Verb: DIAGNOSES
Equipment Class: Annunciator
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

```
  Recovery Considered      Median:  .5000000    UCB:  .8162635  LCB:  .3062737
                             Mean:  .5464231     EF:   2
```

Taxonomy Level: 3
Matrix: 16
Page Number: 1600667

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: CRT Text
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Considered      Median:  .0306587    UCB:  .0539172  LCB:  .0174334
                             Mean:  .0335052     EF:   2
```

Taxonomy Level: 3
Matrix: 16
Page Number: 1601066

Job Title: Personnel
Human Action Verb: READS
Equipment Class: SUMMARY OF QUANTITATIVE DISPLAYS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP:	.0011668	UCB:	.0027692	LCB:	.0004916
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP:	.0024939	UCB:	.0055065	LCB:	.0011295
ERRORS OF COMMISSION RECOVERY NOT CONSIDERED	HEP:	.0408166	UCB:	.1041177	LCB:	.0160010

Taxonomy Level: 3
Matrix: 16
Page Number: 1601067

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: SUMMARY OF QUANTITATIVE DISPLAYS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY CONSIDERED HEP: .0323191 UCB: .0559229 LCB: .0186779

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0045778 UCB: .0079137 LCB: .0026481

Taxonomy Level: 3
Matrix: 16 Page Number: 1601166

Job Title: Personnel
Human Action Verb: READS
Equipment Class: Quantitative Displays
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:

Recovery Not Considered	Median:	.3162278	UCB:	.7071068	LCB:	.1414214
	Mean:	.3455883	EF:	2		

Taxonomy Level: 3
Matrix: 16
Page Number: 1601266

Job Title: Personnel
Human Action Verb: READS
Equipment Class: Counter-Digital Readout
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error: Recovery Considered	Median:	.0000500	UCB:	.0030000	LCB:	.0000090
	Mean:	.0002341	EF:	18		
Commission Error: Recovery Not Considered	Median:	.0006800	UCB:	.0068000	LCB:	.0000680
	Mean:	.0018114	EF:	10		

Taxonomy Level: 3
Matrix: 16

Page Number: 1601366

Job Title: Personnel
Human Action Verb: READS
Equipment Class: Meter
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Considered
Median: .0011668 UCB: .0027692 LCB: .0004916
Mean: .0012751 EF: 2

Commission Error:
Recovery Considered
Median: .0058857 UCB: .0165115 LCB: .0020980
Mean: .0073564 EF: 3

Taxonomy Level: 3
Matrix: 16

Page Number: 1601367

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: Meter
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell NEPs (combined from Task NEPs)

Taxonomy Level: 3
Matrix: 16
Page Number: 1601566

Job Title: Personnel
Human Action Verb: READS
Equipment Class: Chart Recorder
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Considered Median: .0031623 UCB: .0099773 LCB: .0010023
Mean: .0039525 EF: 3

Taxonomy Level: 3
Matrix: 16
Page Number: 1601567

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: Chart Recorder
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Not Considered   Median:  .0034641    UCB:  .0075329  LCB:  .0015930
                              Mean:  .0037857     EF:   2
```

Taxonomy Level: 3
Matrix: 16 Page Number: 1601667

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: CRT Graphic Display
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error: Recovery Considered	Median:	.0751880	UCB:	.7518800	LCB:	.0075188
	Mean:	.2002883	EF:	10		
Commission Error: Recovery Not Considered	Median:	.1278195	UCB:	1.0000000	LCB:	.0127820
	Mean:	.3119283	EF:	9		

Taxonomy Level: 3
Matrix: 16

Page Number: 1601767

Job Title: Personnel
Human Action Verb: MONITORS
Equipment Class: CRT Alphanumeric Display
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Considered	Median:	.0306578	UCB:	.0539155	LCB:	.0174328
	Mean:	.0335043	EF:	2		

Taxonomy Level: 3
Matrix: 16 Page Number: 1603060

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: SUMMARY OF TWO-POSITION SWITCHES
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0046416 UCB: .0136574 LCB: .0015775

Taxonomy Level: 3
Matrix: 16

Page Number: 1603063

Job Title: Personnel
Human Action Verb: SELECTS
Equipment Class: SUMMARY OF TWO-POSITION SWITCHES
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP:	.0015874	UCB:	.0045049	LCB:	.0005594
ERRORS OF COMMISSION RECOVERY NOT CONSIDERED	HEP:	.0007273	UCB:	.0011636	LCB:	.0004545

Taxonomy Level: 3
Matrix: 16 Page Number: 1603160

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: Two-Position Switches
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0046416 UCB: .0136574 LCB: .0015775
Mean: .0058014 EF: 3

Taxonomy Level: 3
Matrix: 16 Page Number: 1603163

Job Title: Personnel
Human Action Verb: SELECTS
Equipment Class: Two-Position Switches
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:						
Recovery Considered	Median:	.0015874	UCB:	.0045049	LCB:	.0005594
	Mean:	.0019840	EF:	3		

Taxonomy Level: 3
Matrix: 16 Page Number: 1603363

Job Title: Personnel
Human Action Verb: SELECTS
Equipment Class: Push-Button (Other)
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0007273 UCB: .0011636 LCB: .0004545
Mean: .0007948 EF: 2

Taxonomy Level: 3
Matrix: 16
Page Number: 1605060

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: SUMMARY OF MULTIPOSITION SELECTORS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION RECOVERY CONSIDERED	HEP: .0030000	UCB: .0300000	LCB: .0003000
ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP: .0012247	UCB: .0046972	LCB: .0003193
ERRORS OF COMMISSION RECOVERY NOT CONSIDERED	HEP: .0084090	UCB: .0211952	LCB: .0033362

Taxonomy Level: 3
Matrix: 16
Page Number: 1605160

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: Multiposition Selectors
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Considered	Median:	.0030000	UCB:	.0300000	LCB:	.0003000
	Mean:	.0079915	EF:	10		

Commission Error:

Recovery Considered	Median:	.0030000	UCB:	.0200000	LCB:	.0005000
	Mean:	.0054297	EF:	6		

Taxonomy Level: 3
Matrix: 16 Page Number: 1605360

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: Rotary Switch
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error: Recovery Considered	Median:	.0005000	UCB:	.0040000	LCB:	.0000800
	Mean:	.0010066	EF:	7		
Commission Error: Recovery Not Considered	Median:	.0084090	UCB:	.0211952	LCB:	.0033362
	Mean:	.0105101	EF:	3		

Taxonomy Level: 3
Matrix: 16

Page Number: 1606062

Job Title: Personnel
Human Action Verb: ADJUSTS
Equipment Class: SUMMARY OF CONTINUOUSLY VARIABLE CONTROLS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0030000 UCB: .0090000 LCB: .0010000

Taxonomy Level: 3
Matrix: 16 Page Number: 1606162

Job Title: Personnel
Human Action Verb: ADJUSTS
Equipment Class: Continuously Variable Controls
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Not Considered   Median:  .0030000    UCB:  .0090000  LCB:  .0010000
                              Mean:  .0037496     EF:   3
```

Taxonomy Level: 3
Matrix: 16
Page Number: 1607070

Job Title: Personnel
Human Action Verb: CALCULATES
Equipment Class: SUMMARY OF KEYBORADS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION RECOVERY CONSIDERED	HEP: .5000000	UCB: 1.0000000	LCB: .2500000
ERRORS OF COMMISSION RECOVERY NOT CONSIDERED	HEP: .1000000	UCB: .3000000	LCB: .0333333

Taxonomy Level: 3
Matrix: 16 Page Number: 1607270

Job Title: Personnel
Human Action Verb: CALCULATES
Equipment Class: Calculator
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error: Recovery Considered	Median:	.5000000	UCB:	1.0000000	LCB:	.2500000
	Mean:	.5464231	EF:	2		
Commission Error: Recovery Not Considered	Median:	.1000000	UCB:	.3000000	LCB:	.0333333
	Mean:	.1249869	EF:	3		

Taxonomy Level: 3
Matrix: 16
Page Number: 1615061

Job Title: Personnel
Human Action Verb: USES
Equipment Class: SUMMARY OF PRINTED COMMUNICATIONS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0237144 UCB: .0467447 LCB: .0120307

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .5000000 UCB: 1.0000000 LCB: .2500000

Taxonomy Level: 3
Matrix: 16
Page Number: 1615066

Job Title: Personnel
Human Action Verb: READS
Equipment Class: SUMMARY OF PRINTED COMMUNICATIONS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION
RECOVERY CONSIDERED HEP: .0070000 UCB: .0300000 LCB: .0005000

Taxonomy Level: 3
Matrix: 16 Page Number: 1615072

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: SUMMARY OF PRINTED COMMUNICATIONS
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF OMISSION
RECOVERY NOT CONSIDERED HEP: .0030000 UCB: .0055120 LCB: .0016328

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0030000 UCB: .0055120 LCB: .0016328

250

Taxonomy Level: 3
Matrix: 16

Page Number: 1615161

Job Title: Personnel
Human Action Verb: USES
Equipment Class: Printed Communications
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0100000	UCB:	.0300000	LCB:	.0033333
	Mean:	.0124987	EF:	3		

Commission Error:

Recovery Not Considered	Median:	.5000000	UCB:	1.0000000	LCB:	.2500000
	Mean:	.5464231	EF:	2		

Taxonomy Level: 3
Matrix: 16 Page Number: 1615172

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Printed Communications
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		
Commission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		

Taxonomy Level: 3
Matrix: 16
Page Number: 1615272

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Tag
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		

Commission Error:

Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		

Taxonomy Level: 3
Matrix: 16
Page Number: 1615372

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Log Book
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		
Commission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		

Taxonomy Level: 3
Matrix: 16
Page Number: 1615472

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Administrative Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Not Considered Median: .0030000 UCB: .0150000 LCB: .0006000
Mean: .0048418 EF: 5

Commission Error:
Recovery Not Considered Median: .0030000 UCB: .0150000 LCB: .0006000
Mean: .0048418 EF: 5

Taxonomy Level: 3
Matrix: 16 Page Number: 1615561

Job Title: Personnel
Human Action Verb: USES
Equipment Class: Operating Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Not Considered   Median:  .0070711   UCB:  .0253210  LCB:  .0019746
                              Mean:  .0100861    EF:   4
```

Taxonomy Level: 3
Matrix: 16 Page Number: 1615572

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Operating Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Not Considered   Median:  .0030000   UCB:  .0150000  LCB:  .0006000
                              Mean:  .0048418    EF:  5
```

```
Commission Error:
  Recovery Not Considered   Median:  .0030000   UCB:  .0150000  LCB:  .0006000
                              Mean:  .0048418    EF:  5
```

Taxonomy Level: 3
Matrix: 16 Page Number: 1615661

Job Title: Personnel
Human Action Verb: USES
Equipment Class: Maintenance Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Omission Error:
  Recovery Not Considered   Median:  .3000000   UCB:  .9000000  LCB:  .1000000
                              Mean:  .3749606    EF:   3
```

Taxonomy Level: 3
Matrix: 16

Page Number: 1615672

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Maintenance Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		
Commission Error:						
Recovery Not Considered	Median:	.0030000	UCB:	.0150000	LCB:	.0006000
	Mean:	.0048418	EF:	5		

Taxonomy Level: 3
Matrix: 16

Page Number: 1615761

Job Title: Personnel
Human Action Verb: USES
Equipment Class: Test Or Calibration Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:
Recovery Not Considered

Median: .0500000	UCB: .2500000	LCB: .0100000
Mean: .0806966	EF: 5	

Taxonomy Level: 3
Matrix: 16 Page Number: 1615772

Job Title: Personnel
Human Action Verb: WRITES
Equipment Class: Test Or Calibration Procedure
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Omission Error:

```
  Recovery Not Considered   Median:  .0030000    UCB:  .0150000  LCB:  .0006000
                              Mean:  .0048418     EF:   5
```

Commission Error:

```
  Recovery Not Considered   Median:  .0030000    UCB:  .0150000  LCB:  .0006000
                              Mean:  .0048418     EF:   5
```

Taxonomy Level: 3
Matrix: 16 Page Number: 1615866

Job Title: Personnel
Human Action Verb: READS
Equipment Class: Graph
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

```
Commission Error:
  Recovery Considered       Median:  .0070000   UCB:  .0300000  LCB:  .0005000
                              Mean:  .0155643    EF:   8
```

Taxonomy Level: 3
Matrix: 16

Page Number: 1618060

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: SUMMARY OF EQUIPMENT - NONSPECIFIC
NSSS Vendor/Equipment Level: Displays/Instr/Controls

ERRORS OF COMMISSION
RECOVERY NOT CONSIDERED HEP: .0007135 UCB: .0012278 LCB: .0004147

Taxonomy Level: 3
Matrix: 16
Page Number: 1618160

Job Title: Personnel
Human Action Verb: POSITIONS
Equipment Class: Equipment - Nonspecific
NSSS Vendor/Equipment Level: Displays/Instr/Controls

Cell HEPs (combined from Task HEPs)

Commission Error:
Recovery Not Considered Median: .0007135 UCB: .0012278 LCB: .0004147
Mean: .0007797 EF: 2

APPENDIX B

MECHANICAL COMPONENT DESIGN CODES

Mechanical Component Design Codes

Code	Description
ACC	Accumulators (closed, pressurized)
ACCUM	Accumulators (closed, pressurized)
ACU	Air Conditioning Units/Chillers
ACUCS	Chillers
ACUCU	Air Conditioning Units
ADY	Air Dryers
ADYAB	Absorption
ADYAD	ADYsorption
ADYHL	Heatless
ADYHR	Heat Reactivated
ADYRF	Refrigerated
ADYXX	Unknown
ADYZZ	Other
BLC	Blowers/Compressors
BLCBL	Blowers
BLCGC	Gas Circulator
BLCMP	Compressors
BLCSC	Superchargers
BLCTC	Turbochargers
BLCXX	Unknown
BLCZZ	Other
CON	Control Rods
CONRD	Control Rods
CRD	Control Rod Drives
CRDRV	Control Rod Drives
CTM	Controllers, Mechanical
CTMHY	Hydraulic
CTMMC	Mechanical
CTMPN	Pneumatic
CTMXX	Unknown
CTMZZ	Other
DEM	Demineralizers
DEMAN	Anion
DEMCA	Cation
DEMMB	Mixed Bed
DEMPR	Powdered Resin
DEMXX	Unknown

Mechanical Component Design Codes

Code	Description
DEMZZ	Other
DPA	Dampers, Pneumatic Operator
DPAOB	Opposed Blade
DPAPB	Parallel Blade
DPAPL	Proportioning Louver
DPASB	Single Blade
DPAXX	Unknown
DPAZZ	Other
DPH	Dampers, Hydraulic Operator
DPHOB	Opposed Blade
DPHPB	Parallel Blade
DPHPL	Proportioning Louver
DPHSB	Single Blade
DPHXX	Unknown
DPHZZ	Other
DPM	Dampers, Motor Operator
DPMOB	Opposed Blade
DPMPB	Parallel Blade
DPMPL	Proportioning Louver
DPMSB	Single Blade
DPMXX	Unknown
DPMZZ	Other
DPN	Dampers, Exclusive of Operators
DPNOB	Opposed Blade
DPNPB	Parallel Blade
DPNPL	Proportioning Louver
DPNSB	Single Blade
DPNXX	Unknown
DPNZZ	Other
DPO	Dampers, Manual Operator
DPOOB	Opposed Blade
DPOPB	Parallel Blade
DPOPL	Proportioning Louver
DPOSB	Single Blade
DPOXX	Unknown
DPOZZ	Other
DPX	Dampers, Unknown Operator
DPXOB	Opposed Blade
DPXPB	Parallel Blade

Mechanical Component Design Codes

Code	Description
DPXPL	Proportioning Louver
DPXSB	Single Blade
DPXXX	Unknown
DPXZZ	Other
DPZ	Dampers, Other Operator
DPZOB	Opposed Blade
DPZPB	Parallel Blade
DPZPL	Proportioning Louver
DPZSB	Single Blade
DPZXX	Unknown
DPZZZ	Other
EDJ	Eductors/Ejectors
EDJEC	Ejectors
EDJUC	Eductors
ENG	Engines
ENGDG	Diesel
ENGGE	Gasoline
ENGXX	Unknown
ENGZZ	Other
FCU	Fan Cooler Units
FCUFC	Fan Cooler Units
FIT	Fittings
FITAG	Angle
FITCP	Coupling
FITEL	Elbow
FITFG	Flange
FITNP	Nipple
FITPG	Plug
FITRD	Reducer
FITTB	Tubing
FITTE	Tee (T)
FITUN	Union
FITWL	Well, Process Monitor
FITYE	Wye (Y)
FITZZ	Other
FLT	Filters
FLTCC	Charcoal
FLTHE	HEPA
FLTXX	Unknown

Mechanical Component Design Codes

Code	Description
FLTZZ	Other
FUE	Fuel Assemblies (fuel elements)
FUELA	Fuel Assemblies (fuel elements)
FVN	Fans, Ventilators
FVNFN	Fans
FVNVT	Ventilators
HTX	Heat Exchangers
HTXBL	Boiler
HTXCD	Condenser
HTXCO	Cooler
HTXEV	Evaporator
HTXHT	Heater
HTXIC	Ice Condenser
HTXSG	Steam Generator
HTXSH	Superheater
HTXXX	Unknown
HTXZZ	Other
MFI	Mechanical Function Items
MFIBR	Brake
MFICL	Clutch
MFICP	Coupling
MFIGV	Governor
MFITI	Timer
MFIZZ	Other
MPI	Miscellaneous Piping Items
MPIDF	Diaphragm
MPINZ	Nozzle
MPIOR	Orifice
MPIRD	Rupture Disc
MPISL	Sensing Line
MPP	Mechanical Piece Parts
MPPBR	Bearing/Bushing
MPPBT	Belt
MPPFS	Fastener
MPPGR	Gear
MPPHO	Hose
MPPZZ	Other

Mechanical Component Design Codes

Code	Description
MTH	Motors, Mechanical
MTHHY	Hydraulic
MTHPN	Pneumatic
PEN	Penetrations
PENAC	Access
PENEL	Electrical
PENEQ	Equipment
PENFU	Fuel
PENHD	Handling
PENIN	Instrument
PENPP	Piping
PENPR	Personnel
PENXX	Unknown
PENZZ	Other
PIP	Pipe
PIPLG	Pipe, >= 3 Inches, ID
PIPSM	Pipe, < 3 Inches, ID
PIPXX	Pipe, unknown size
PPD	Pumps, Diesel Driven
PPDAX	Axial
PPDCF	Centrifugal
PPDDP	Diaphragm
PPDGR	Gear
PPDRD	Radial
PPDRP	Reciprocating
PPDRT	Rotary
PPDVN	Vane
PPDXX	Unknown
PPDZZ	Other
PPE	Pump, Electromagnetic
PPEMP	Pump, Electromagnetic
PPJ	Pump, Jet
PPJMP	Pump, Jet
PPM	Pumps, Motor Driven
PPMAX	Axial
PPMCF	Centrifugal
PPMDP	Diaphragm
PPMGR	Gear

Mechanical Component Design Codes

Code	Description
PPMRD	Radial
PPMRP	Reciprocating
PPMRT	Rotary
PPMVN	Vane
PPMXX	Unknown
PPMZZ	Other
PPN	Pumps, Exclusive of Drivers
PPNAX	Axial
PPNCF	Centrifugal
PPNDP	Diaphragm
PPNGR	Gear
PPNRD	Radial
PPNRP	Reciprocating
PPNRT	Rotary
PPNVN	Vane
PPNXX	Unknown
PPNZZ	Other
PPT	Pumps, Steam Turbine Driven
PPTAX	Axial
PPTCF	Centrifugal
PPTDP	Diaphragm
PPTGR	Gear
PPTRD	Radial
PPTRP	Reciprocating
PPTRT	Rotary
PPTVN	Vane
PPTXX	Unknown
PPTZZ	Other
PPV	Pumps, Vacuum
PPVCP	Cryopump
PPVDP	Diffusion
PPVIP	Ion
PPVMP	Mechanical
PPVSP	Sorption
PPVTM	Turbomolecular
PPVXX	Unknown
PPVZZ	Other
PPX	Pumps, Unknown Driver
PPXAX	Axial
PPXCF	Centrifugal
PPXDP	Diaphragm

Mechanical Component Design Codes

Code	Description
PPXGR	Gear
PPXRD	Radial
PPXRP	Reciprocating
PPXRT	Rotary
PPXVN	Vane
PPXXX	Unknown
PPXZZ	Other
PPZ	Pumps, Other Driver
PPZAX	Axial
PPZCF	Centrifugal
PPZDP	Diaphragm
PPZGR	Gear
PPZRD	Radial
PPZRP	Reciprocating
PPZRT	Rotary
PPZVN	Vane
PPZXX	Unknown
PPZZZ	Other
REC	Recombiners
RECCT	Catalytic
RECFL	Flame
RECTM	Thermal
RECXX	Unknown
RECZZ	Other
RES	Reservoirs (open, not pressurized)
RESVR	Reservoirs (open, not pressurized)
SFI	Structural Function Items
SFIAK	Anchors
SFIEJ	Expansion Joints
SFIHG	Hangers
SFISB	Snubbers
SFISU	Supports
SFIXX	Unknown
SFIZZ	Other
STR	Strainers
STRDU	Duplex
STRSC	Self-cleaning
STRSP	Simplex
STRSS	Screens, Stationary
STRST	Screens, Traveling

Mechanical Component Design Codes

Code	Description
STRXX	Unknown
STRZZ	Other
TAN	Tanks (closed, not pressurized)
TANKS	Tanks (closed, not pressurized)
TRA	Train (Series of Mechanical/Electrical Components)
TRAIN	Train (Series of Mechanical/Electrical Components)
TRB	Turbines
TRBCB	Combustion
TRBHY	Hydro
TRBST	Steam
TRBXX	Unknown
TRBZZ	Other
VLC	Valves, Check
VLCHY	Hydraulic Operator
VLCMN	Manual Operator (mechanical handweel)
VLCMO	Motor Operator
VLCNO	No Operator
VLCNT	No Operator (tilting disk check valve)
VLCPN	Pneumatic Operator
VLCXX	Unknown Operator
VLCZZ	Other Operator
VLD	Valves, Mechanical (dp/spring) Operator
VLDAN	Angle
VLDBF	Butterfly
VLDBL	Ball
VLDDP	Diaphragm
VLDGL	Globe
VLDGT	Gate
VLDND	Needle
VLDPL	Plug
VLDXX	Unknown
VLDZZ	Other
VLE	Valves, Explosive Operator (squib)
VLEAN	Angle
VLEBF	Butterfly
VLEBL	Ball
VLEDP	Diaphragm
VLEGL	Globe
VLEGT	Gate

Mechanical Component Design Codes

Code	Description
VLEND	Needle
VLEPL	Plug
VLEXX	Unknown
VLEZZ	Other
VLF	Valves, Float Operator
VLFAN	Angle
VLFBF	Butterfly
VLFBL	Ball
VLFDP	Diaphragm
VLFGL	Globe
VLFGT	Gate
VLFND	Needle
VLFPL	Plug
VLFXX	Unknown
VLFZZ	Other
VLH	Valves, Hydraulic Operator
VLHAN	Angle
VLHBF	Butterfly
VLHBL	Ball
VLHDP	Diaphragm
VLHGL	Globe
VLHGT	Gate
VLHND	Needle
VLHPL	Plug
VLHXX	Unknown
VLHZZ	Other
VLM	Motor Operator
VLMAN	Angle
VLMBF	Butterfly
VLMBL	Ball
VLMDP	Diaphragm
VLMGL	Globe
VLMGT	Gate
VLMND	Needle
VLMPL	Plug
VLMXX	Unknown
VLMZZ	Other
VLN	Valves, Exclusive of Operators
VLNAN	Angle
VLNBF	Butterfly
VLNBL	Ball

Mechanical Component Design Codes

Code	Description
VLNDP	Diaphragm
VLNGL	Globe
VLNGT	Gate
VLNND	Needle
VLNPL	Plug
VLNXX	Unknown
VLNZZ	Other
VLO	Valves, Manual Operator (mechanical handwheel)
VLOAN	Angle
VLOBF	Butterfly
VLOBL	Ball
VLODP	Diaphragm
VLOGL	Globe
VLOGT	Gate
VLOND	Needle
VLOPL	Plug
VLOXX	Unknown
VLOZZ	Other
VLP	Pneumatic Operator
VLPAN	Angle
VLPBF	Butterfly
VLPBL	Ball
VLPDP	Diaphragm
VLPGL	Globe
VLPGT	Gate
VLPND	Needle
VLPPL	Plug
VLPXX	Unknown
VLPZZ	Other
VLR	Valves, Relief
VLRDA	Direct Acting
VLRPI	Indirect Acting, Pilot Operated
VLRPW	Indirect Acting, Power Operated
VLRPX	Indirect Acting, Unknown Operator
VLRPZ	Indirect Acting, Other Operator
VLRXX	Unknown
VLRZZ	Other
VLS	Solenoid Operator
VLSAN	Angle
VLSBF	Butterfly
VLSBL	Ball

Mechanical Component Design Codes

Code	Description
VLSDP	Diaphragm
VLSGL	Globe
VLSGT	Gate
VLSND	Needle
VLSPL	Plug
VLSXX	Unknown
VLSZZ	Other
VLV	Valves, Vacuum Breakers
VLVBK	Valves, Vacuum Breakers
VLX	Unknown Operator
VLXAN	Angle
VLXBF	Butterfly
VLXBL	Ball
VLXDP	Diaphragm
VLXGL	Globe
VLXGT	Gate
VLXND	Needle
VLXPL	Plug
VLXXX	Unknown
VLZ	Other Operator
VLZAN	Angle
VLZBF	Butterfly
VLZBL	Ball
VLZDP	Diaphragm
VLZGL	Globe
VLZGT	Gate
VLZND	Needle
VLZPL	Plug
VLZXX	Unknown
VOP	Valve Operators
VOPDO	Mechanical (dp/spring) Operator
VOPEO	Explosive Operator (Squib)
VOPFO	Float Operator
VOPHO	Hydraulic Operator
VOPMO	Motor Operator
VOPNO	Manual Operator (mechanical handwheel)
VOPPO	Pneumatic Operator
VOPSO	Solenoid Operator
VOPXO	Unknown Operator
VOPZO	Other Operator

Mechanical Component Design Codes

Code	Description
VSL	Vessels (closed, pressurized)
VSLCD	Containment/Drywell
VSLPZ	Pressurizer
VSLRV	Reactor Vessel
VSLSP	Suppression Pool/Wetwell
VSLTO	Torus
VSLXX	Unknown
VSLZZ	Other

APPENDIX C

HARDWARE COMPONENT FAILURE DATA SUMMARY AGGREGATIONS

Mechanical Component Failure Event Aggregations

Component: Air Conditioning Units/Chillers
Failure: Fails to Operate Group
Records Entered: 3, Aggregated: 3

Demand-Aggregations		Hourly-Aggregations	
Median:	1.300E-002	Median:	1.101E-005
Upper Bound:	2.944E-002	Upper Bound:	3.568E-005

Component: Air Conditioning Units/Chillers
Failure: Fails to Operate
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	1.101E-005
Upper Bound:	------E----	Upper Bound:	3.568E-005

Component: Air Conditioning Units/Chillers
Failure: Fails to Start
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	1.300E-002	Median:	------E----
Upper Bound:	2.944E-002	Upper Bound:	------E----

Component: Dampers, Unknown Operator
Failure: Fails to Operate Group
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	2.671E-003	Median:	------E----
Upper Bound:	6.085E-003	Upper Bound:	------E----

Mechanical Component Failure Event Aggregations

Component: Dampers, Unknown Operator
Failure: Fails to Operate
Records Entered: 1, Aggregated: 1

	Demand-Aggregations	Hourly-Aggregations
Median:	2.671E-003	------E----
Upper Bound:	6.085E-003	------E----

Component: Fan Cooler Units
Failure: Fails to Operate Group
Records Entered: 4, Aggregated: 4

	Demand-Aggregations	Hourly-Aggregations
Median:	1.800E-003	7.161E-006
Upper Bound:	2.593E-003	2.088E-005

Component: Fan Cooler Units
Failure: Fails to Run
Records Entered: 2, Aggregated: 2

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	7.161E-006
Upper Bound:	------E----	2.088E-005

Component: Fan Cooler Units
Failure: Fails to Start
Records Entered: 2, Aggregated: 2

	Demand-Aggregations	Hourly-Aggregations
Median:	1.800E-003	------E----
Upper Bound:	2.593E-003	------E----

Mechanical Component Failure Event Aggregations

Component: Fans, Ventilators
Failure: Fails to Operate Group
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	8.553E-004	Median:	1.098E-006
Upper Bound:	4.786E-003	Upper Bound:	6.160E-006

Component: Fans, Ventilators
Failure: Fails to Run
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	1.098E-006
Upper Bound:	------E----	Upper Bound:	6.160E-006

Component: Fans, Ventilators
Failure: Fails to Start
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	8.553E-004	Median:	------E----
Upper Bound:	4.786E-003	Upper Bound:	------E----

Component: Heat Exchangers
Failure: Blockage Group
Records Entered: 4, Aggregated: 4

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	9.164E-007
Upper Bound:	------E----	Upper Bound:	5.139E-006

Mechanical Component Failure Event Aggregations

Component: Heat Exchangers
Failure: Plugged
Records Entered: 4, Aggregated: 4

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	9.164E-007
Upper Bound:	------E----	5.139E-006

Component: Heat Exchangers
Failure: Leakage Group
Records Entered: 2, Aggregated: 2

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	7.518E-007
Upper Bound:	------E----	4.216E-006

Component: Heat Exchangers
Failure: Leakage
Records Entered: 2, Aggregated: 2

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	7.518E-007
Upper Bound:	------E----	4.216E-006

Component: Pumps, Diesel Driven
Failure: Fails to Operate Group
Records Entered: 5, Aggregated: 5

	Demand-Aggregations	Hourly-Aggregations
Median:	4.320E-003	6.403E-002
Upper Bound:	2.799E-002	1.663E-001

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Mechanical Component Failure Event Aggregations

```
Component: Pumps, Diesel Driven
  Failure: Fails to Run                       Records Entered:  1, Aggregated:  1

--------Demand-Aggregations----------------------Hourly-Aggregations-----------

         Median: ------E----         |          Median:  6.403E-002
    Upper Bound: ------E----         |     Upper Bound:  1.663E-001
--------------------------------------------------------------------------------


Component: Pumps, Diesel Driven
  Failure: Fails to Start                     Records Entered:  4, Aggregated:  4

--------Demand-Aggregations----------------------Hourly-Aggregations-----------

         Median:  4.320E-003         |          Median: ------E----
    Upper Bound:  2.799E-002         |     Upper Bound: ------E----
--------------------------------------------------------------------------------


Component: Pumps, Motor Driven
  Failure: Fails to Operate Group             Records Entered:122, Aggregated:122

--------Demand-Aggregations----------------------Hourly-Aggregations-----------

         Median:  1.558E-003         |          Median:  1.153E-005
    Upper Bound:  1.062E-002         |     Upper Bound:  8.425E-005
--------------------------------------------------------------------------------


Component: Pumps, Motor Driven
  Failure: Fails to Operate                   Records Entered:  2, Aggregated:  2

--------Demand-Aggregations----------------------Hourly-Aggregations-----------

         Median: ------E----         |          Median:  4.175E-005
    Upper Bound: ------E----         |     Upper Bound:  4.961E-005
--------------------------------------------------------------------------------
```

Mechanical Component Failure Event Aggregations

Component: Pumps, Motor Driven
Failure: Fails to Run
Records Entered: 62, Aggregated: 62

Demand Aggregations		Hourly Aggregations	
Median:	------E----	Median:	1.128E-005
Upper Bound:	------E----	Upper Bound:	8.387E-005

Component: Pumps, Motor Driven
Failure: Fails to Start
Records Entered: 58, Aggregated: 58

Demand Aggregations		Hourly Aggregations	
Median:	1.558E-003	Median:	------E----
Upper Bound:	1.062E-002	Upper Bound:	------E----

Component: Pumps, Steam Turbine Driven
Failure: Fails to Operate Group
Records Entered: 14, Aggregated: 14

Demand Aggregations		Hourly Aggregations	
Median:	5.990E-003	Median:	2.177E-005
Upper Bound:	3.308E-002	Upper Bound:	4.967E-005

Component: Pumps, Steam Turbine Driven
Failure: Fails to Operate
Records Entered: 1, Aggregated: 1

Demand Aggregations		Hourly Aggregations	
Median:	------E----	Median:	1.236E-002
Upper Bound:	------E----	Upper Bound:	4.005E-002

Mechanical Component Failure Event Aggregations

Component: Pumps, Steam Turbine Driven
Failure: Fails to Run
Records Entered: 6, Aggregated: 6

	Demand Aggregations	Hourly Aggregations
Median:	------E----	1.491E-005
Upper Bound:	------E----	3.872E-005

Component: Pumps, Steam Turbine Driven
Failure: Fails to Start
Records Entered: 7, Aggregated: 7

	Demand Aggregations	Hourly Aggregations
Median:	5.990E-003	------E----
Upper Bound:	3.308E-002	------E----

Component: Pumps, Unknown Driver
Failure: Fails to Operate Group
Records Entered: 12, Aggregated: 12

	Demand Aggregations	Hourly Aggregations
Median:	3.552E-003	8.855E-007
Upper Bound:	1.203E-002	7.422E-005

Component: Pumps, Unknown Driver
Failure: Fails to Run
Records Entered: 9, Aggregated: 9

	Demand Aggregations	Hourly Aggregations
Median:	------E----	8.855E-007
Upper Bound:	------E----	7.422E-005

Mechanical Component Failure Event Aggregations

Component: Pumps, Unknown Driver
Failure: Fails to Start
Records Entered: 3, **Aggregated:** 3

Demand Aggregations		Hourly Aggregations	
Median:	3.552E-003	**Median:**	------E----
Upper Bound:	1.203E-002	**Upper Bound:**	------E----

Component: Valves, Check
Failure: Fails to Operate Group
Records Entered: 12, **Aggregated:** 12

Demand Aggregations		Hourly Aggregations	
Median:	1.000E-004	**Median:**	------E----
Upper Bound:	9.762E-004	**Upper Bound:**	------E----

Component: Valves, Check
Failure: Fails to Close
Records Entered: 5, **Aggregated:** 5

Demand Aggregations		Hourly Aggregations	
Median:	6.656E-004	**Median:**	------E----
Upper Bound:	2.520E-003	**Upper Bound:**	------E----

Component: Valves, Check
Failure: Fails to Open
Records Entered: 7, **Aggregated:** 7

Demand Aggregations		Hourly Aggregations	
Median:	2.100E-005	**Median:**	------E----
Upper Bound:	1.178E-004	**Upper Bound:**	------E----

```
Component: Valves, Check
  Failure: Leakage Group                    Records Entered:  2, Aggregated:  2

----------Demand-Aggregations--------------------------Hourly-Aggregations----------

             Median: ------E----            |          Median:  1.104E-006
        Upper Bound: ------E----            |     Upper Bound:  3.579E-006
```

```
Component: Valves, Check
  Failure: Internal Leakage                 Records Entered:  2, Aggregated:  2

----------Demand-Aggregations--------------------------Hourly-Aggregations----------

             Median: ------E----            |          Median:  1.104E-006
        Upper Bound: ------E----            |     Upper Bound:  3.579E-006
```

```
Component: Valves, Check
  Failure: Spurious Operation Group         Records Entered:  3, Aggregated:  3

----------Demand-Aggregations--------------------------Hourly-Aggregations----------

             Median: ------E----            |          Median:  3.960E-007
        Upper Bound: ------E----            |     Upper Bound:  2.221E-006
```

```
Component: Valves, Check
  Failure: Spurious Close (Transfer Closed) Records Entered:  3, Aggregated:  3

----------Demand-Aggregations--------------------------Hourly-Aggregations----------

             Median: ------E----            |          Median:  3.960E-007
        Upper Bound: ------E----            |     Upper Bound:  2.221E-006
```

Mechanical Component Failure Event Aggregations

```
Component: Valves, Hydraulic Operator
  Failure: Fails to Operate Group            Records Entered:  1, Aggregated:  1

-------Demand Aggregations-----------------------Hourly Aggregations---------------
                                     |
          Median:  3.912E-003        |           Median: ------E----
     Upper Bound:  6.419E-003        |      Upper Bound: ------E----
-----------------------------------------------------------------------------------
```

```
Component: Valves, Hydraulic Operator
  Failure: Fails to Operate                  Records Entered:  1, Aggregated:  1

-------Demand Aggregations-----------------------Hourly Aggregations---------------
                                     |
          Median:  3.912E-003        |           Median: ------E----
     Upper Bound:  6.419E-003        |      Upper Bound: ------E----
-----------------------------------------------------------------------------------
```

```
Component: Valves, Hydraulic Operator
  Failure: Spurious Operation Group          Records Entered:  1, Aggregated:  1

-------Demand Aggregations-----------------------Hourly Aggregations---------------
                                     |
          Median: ------E----        |           Median:  1.054E-006
     Upper Bound: ------E----        |      Upper Bound:  5.908E-006
-----------------------------------------------------------------------------------
```

```
Component: Valves, Hydraulic Operator
  Failure: Spurious Close (Transfer Closed)  Records Entered:  1, Aggregated:  1

-------Demand Aggregations-----------------------Hourly Aggregations---------------
                                     |
          Median: ------E----        |           Median:  1.054E-006
     Upper Bound: ------E----        |      Upper Bound:  5.908E-006
-----------------------------------------------------------------------------------
```

Mechanical Component Failure Event Aggregations

Component: Valves, Motor Operator
Failure: Fails to Operate Group
Records Entered: 14, Aggregated: 14

Demand Aggregations		Hourly Aggregations	
Median:	2.966E-003	Median:	------E----
Upper Bound:	1.325E-002	Upper Bound:	------E----

Component: Valves, Motor Operator
Failure: Fails to Close
Records Entered: 4, Aggregated: 4

Demand Aggregations		Hourly Aggregations	
Median:	4.554E-003	Median:	------E----
Upper Bound:	1.427E-002	Upper Bound:	------E----

Component: Valves, Motor Operator
Failure: Fails to Operate
Records Entered: 6, Aggregated: 6

Demand Aggregations		Hourly Aggregations	
Median:	1.877E-003	Median:	------E----
Upper Bound:	1.212E-002	Upper Bound:	------E----

Component: Valves, Motor Operator
Failure: Fails to Open
Records Entered: 4, Aggregated: 4

Demand Aggregations		Hourly Aggregations	
Median:	5.945E-003	Median:	------E----
Upper Bound:	9.208E-003	Upper Bound:	------E----

Mechanical Component Failure Event Aggregations

```
Component: Valves, Motor Operator
  Failure: Spurious Operation Group          Records Entered:  7, Aggregated:  7

---------Demand-Aggregations----------|----------Hourly-Aggregations-----------
                                      |
         Median: ------E----          |          Median:  5.548E-008
    Upper Bound: ------E----          |     Upper Bound:  1.798E-007


Component: Valves, Motor Operator
  Failure: Spurious Close (Transfer Closed)  Records Entered:  3, Aggregated:  3

---------Demand-Aggregations----------|----------Hourly-Aggregations-----------
                                      |
         Median: ------E----          |          Median:  1.520E-008
    Upper Bound: ------E----          |     Upper Bound:  8.525E-008


Component: Valves, Motor Operator
  Failure: Spurious Open (Transfer Open)     Records Entered:  4, Aggregated:  4

---------Demand-Aggregations----------|----------Hourly-Aggregations-----------
                                      |
         Median: ------E----          |          Median:  5.954E-007
    Upper Bound: ------E----          |     Upper Bound:  1.929E-006


Component: Valves, Manual Operator (mechanical handwheel)
  Failure: Spurious Operation Group          Records Entered:  2, Aggregated:  2

---------Demand-Aggregations----------|----------Hourly-Aggregations-----------
                                      |
         Median: ------E----          |          Median:  1.278E-007
    Upper Bound: ------E----          |     Upper Bound:  4.142E-007
```

Mechanical Component Failure Event Aggregations

Component: Valves, Manual Operator (mechanical handwheel)
Failure: Spurious Close (Transfer Closed) Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	1.278E-007
Upper Bound:	------E----	Upper Bound:	4.142E-007

Component: Valves, Pneumatic Operator
Failure: Fails to Operate Group Records Entered: 3, Aggregated: 3

Demand-Aggregations		Hourly-Aggregations	
Median:	1.684E-003	Median:	------E----
Upper Bound:	2.988E-003	Upper Bound:	------E----

Component: Valves, Pneumatic Operator
Failure: Fails to Operate Records Entered: 3, Aggregated: 3

Demand-Aggregations		Hourly-Aggregations	
Median:	1.684E-003	Median:	------E----
Upper Bound:	2.988E-003	Upper Bound:	------E----

Component: Valves, Pneumatic Operator
Failure: Spurious Operation Group Records Entered: 4, Aggregated: 4

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	4.142E-007
Upper Bound:	------E----	Upper Bound:	1.342E-006

Mechanical Component Failure Event Aggregations

Component: Valves, Pneumatic Operator
Failure: Spurious Close (Transfer Closed) Records Entered: 3, Aggregated: 3

Demand-Aggregations	Hourly-Aggregations
Median: ------E----	Median: 4.198E-007
Upper Bound: ------E----	Upper Bound: 1.360E-006

Component: Valves, Pneumatic Operator
Failure: Spurious Open (Transfer Open) Records Entered: 1, Aggregated: 1

Demand-Aggregations	Hourly-Aggregations
Median: ------E----	Median: 7.802E-006
Upper Bound: ------E----	Upper Bound: 4.375E-005

Component: Valves, Relief
Failure: Fails to Operate Group Records Entered: 4, Aggregated: 4

Demand-Aggregations	Hourly-Aggregations
Median: 1.408E-002	Median: ------E----
Upper Bound: 4.501E-002	Upper Bound: ------E----

Component: Valves, Relief
Failure: Fails to Close Records Entered: 2, Aggregated: 2

Demand-Aggregations	Hourly-Aggregations
Median: 2.799E-002	Median: ------E----
Upper Bound: 8.825E-002	Upper Bound: ------E----

Mechanical Component Failure Event Aggregations

Component: Valves, Relief
Failure: Fails to Open
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	6.955E-003	Median:	------E----
Upper Bound:	3.828E-002	Upper Bound:	------E----

Component: Valves, Relief
Failure: Spurious Operation Group
Records Entered: 3, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	3.261E-006
Upper Bound:	------E----	Upper Bound:	3.331E-006

Component: Valves, Relief
Failure: Spurious Open (Transfer Open)
Records Entered: 3, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	------E----	Median:	3.261E-006
Upper Bound:	------E----	Upper Bound:	3.331E-006

Component: Valves, Solenoid Operator
Failure: Fails to Operate Group
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	9.400E-007	Median:	------E----
Upper Bound:	1.396E-006	Upper Bound:	------E----

Mechanical Component Failure Event Aggregations

Component: Valves, Solenoid Operator
Failure: Fails to Close
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	9.400E-007	Median:	------E----
Upper Bound:	2.104E-006	Upper Bound:	------E----

Component: Valves, Solenoid Operator
Failure: Fails to Open
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	9.400E-007	Median:	------E----
Upper Bound:	2.106E-006	Upper Bound:	------E----

Component: Valves, Unknown Operator
Failure: Fails to Operate Group
Records Entered: 7, Aggregated: 7

Demand-Aggregations		Hourly-Aggregations	
Median:	2.357E-002	Median:	1.214E-004
Upper Bound:	7.098E-002	Upper Bound:	1.770E-004

Component: Valves, Unknown Operator
Failure: Fails to Close
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	3.599E-002	Median:	------E----
Upper Bound:	8.516E-002	Upper Bound:	------E----

Mechanical Component Failure Event Aggregations

Component: Valves, Unknown Operator
Failure: Fails to Operate
Records Entered: 1, Aggregated: 1

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	1.214E-004
Upper Bound:	------E----	1.770E-004

Component: Valves, Unknown Operator
Failure: Fails to Open
Records Entered: 4, Aggregated: 4

	Demand-Aggregations	Hourly-Aggregations
Median:	1.601E-002	------E----
Upper Bound:	5.131E-002	------E----

Component: Valves, Unknown Operator
Failure: Spurious Operation Group
Records Entered: 3, Aggregated: 3

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	2.772E-007
Upper Bound:	------E----	9.599E-007

Component: Valves, Unknown Operator
Failure: Spurious Close (Transfer Closed)
Records Entered: 2, Aggregated: 2

	Demand-Aggregations	Hourly-Aggregations
Median:	------E----	1.572E-007
Upper Bound:	------E----	8.490E-007

Component: Valves, Unknown Operator
Failure: Spurious Open (Transfer Open)   Records Entered: 1, Aggregated: 1

Demand Aggregations		Hourly Aggregations	
Median:	------E----	Median:	7.826E-007
Upper Bound:	------E----	Upper Bound:	1.785E-006

Electrical Component Failure Event Aggregations

```
Component: Automatic Transfer Switches
  Failure: Fails to Operate Group           Records Entered:  1, Aggregated:  1

        Demand-Aggregations                     Hourly-Aggregations

          Median:  1.539E-002                  Median: ------E----
     Upper Bound:  4.912E-002             Upper Bound: ------E----


Component: Automatic Transfer Switches
  Failure: Fails to Transfer Electrically   Records Entered:  1, Aggregated:  1

        Demand-Aggregations                     Hourly-Aggregations

          Median:  1.539E-002                  Median: ------E----
     Upper Bound:  4.912E-002             Upper Bound: ------E----


Component: Batteries
  Failure: Fails to Operate Group           Records Entered:  5, Aggregated:  5

        Demand-Aggregations                     Hourly-Aggregations

          Median: ------E----                  Median:  1.545E-006
     Upper Bound: ------E----             Upper Bound:  4.567E-005


Component: Batteries
  Failure: Fails to Operate                 Records Entered:  5, Aggregated:  5

        Demand-Aggregations                     Hourly-Aggregations

          Median: ------E----                  Median:  1.545E-006
     Upper Bound: ------E----             Upper Bound:  4.567E-005
```

Electrical Component Failure Event Aggregations

```
Component: Charger, Battery
  Failure: Fails to Operate Group             Records Entered:  6, Aggregated:  6

--------Demand-Aggregations---------------------------Hourly-Aggregations------------

         Median: ------E----          |          Median:  7.600E-006
    Upper Bound: ------E----          |     Upper Bound:  6.536E-005
```

```
Component: Charger, Battery
  Failure: Fails to Operate                   Records Entered:  6, Aggregated:  6

--------Demand-Aggregations---------------------------Hourly-Aggregations------------

         Median: ------E----          |          Median:  7.600E-006
    Upper Bound: ------E----          |     Upper Bound:  6.536E-005
```

```
Component: Circuit Breakers, Power
  Failure: Fails to Operate Group             Records Entered:  9, Aggregated:  9

--------Demand-Aggregations---------------------------Hourly-Aggregations------------

         Median:  1.776E-004          |          Median: ------E----
    Upper Bound:  1.431E-003          |     Upper Bound: ------E----
```

```
Component: Circuit Breakers, Power
  Failure: Fails to Close                     Records Entered:  3, Aggregated:  3

--------Demand-Aggregations---------------------------Hourly-Aggregations------------

         Median:  1.749E-003          |          Median: ------E----
    Upper Bound:  2.797E-003          |     Upper Bound: ------E----
```

Electrical Component Failure Event Aggregations

Component: Circuit Breakers, Power
Failure: Fails to Operate
Records Entered: 2, Aggregated: 2

	Demand Aggregations		Hourly Aggregations
Median:	1.561E-004	Median:	------E----
Upper Bound:	4.823E-004	Upper Bound:	------E----

Component: Circuit Breakers, Power
Failure: Fails to Open
Records Entered: 4, Aggregated: 4

	Demand Aggregations		Hourly Aggregations
Median:	5.276E-004	Median:	------E----
Upper Bound:	4.110E-003	Upper Bound:	------E----

Component: Circuit Breakers, Power
Failure: Spurious Operation Group
Records Entered: 5, Aggregated: 5

	Demand Aggregations		Hourly Aggregations
Median:	------E----	Median:	3.196E-007
Upper Bound:	------E----	Upper Bound:	4.015E-007

Component: Circuit Breakers, Power
Failure: Spurious Open (Transfer Open)
Records Entered: 5, Aggregated: 5

	Demand Aggregations		Hourly Aggregations
Median:	------E----	Median:	3.196E-007
Upper Bound:	------E----	Upper Bound:	4.015E-007

Electrical Component Failure Event Aggregations

```
Component: Conductors
  Failure: Fails to Operate Group             Records Entered:  4, Aggregated:  4

--------Demand-Aggregations--------|----------Hourly-Aggregations--------------
                                   |
      Median: ------E----          |          Median:  4.332E-008
 Upper Bound: ------E----          |     Upper Bound:  2.429E-007
-------------------------------------------------------------------------------
```

```
Component: Conductors
  Failure: Fails to Operate                   Records Entered:  4, Aggregated:  4

--------Demand-Aggregations--------|----------Hourly-Aggregations--------------
                                   |
      Median: ------E----          |          Median:  4.332E-008
 Upper Bound: ------E----          |     Upper Bound:  2.429E-007
-------------------------------------------------------------------------------
```

```
Component: Electrical Function Items
  Failure: Fails to Operate Group             Records Entered:  1, Aggregated:  1

--------Demand-Aggregations--------|----------Hourly-Aggregations--------------
                                   |
      Median: ------E----          |          Median:  7.479E-007
 Upper Bound: ------E----          |     Upper Bound:  4.194E-006
-------------------------------------------------------------------------------
```

```
Component: Electrical Function Items
  Failure: Fails to Operate                   Records Entered:  1, Aggregated:  1

--------Demand-Aggregations--------|----------Hourly-Aggregations--------------
                                   |
      Median: ------E----          |          Median:  7.479E-007
 Upper Bound: ------E----          |     Upper Bound:  4.194E-006
-------------------------------------------------------------------------------
```

Electrical Component Failure Event Aggregations

```
Component: Electrical Piece Parts
  Failure: Fails to Operate Group           Records Entered:  1, Aggregated:  1

-----------Demand-Aggregations-------------------------Hourly-Aggregations-------------
                                          |
       Median: ------E----                |         Median:  3.010E-006
  Upper Bound: ------E----                |    Upper Bound:  9.754E-006
---------------------------------------------------------------------------------------


Component: Electrical Piece Parts
  Failure: Fails to Operate                 Records Entered:  1, Aggregated:  1

-----------Demand-Aggregations-------------------------Hourly-Aggregations-------------
                                          |
       Median: ------E----                |         Median:  3.010E-006
  Upper Bound: ------E----                |    Upper Bound:  9.754E-006
---------------------------------------------------------------------------------------


Component: Generator, with Diesel Engine Driver
  Failure: Fails to Operate Group           Records Entered:164, Aggregated:164

-----------Demand-Aggregations-------------------------Hourly-Aggregations-------------
                                          |
       Median:  4.786E-003                |         Median:  2.564E-003
  Upper Bound:  1.864E-002                |    Upper Bound:  1.184E-002
---------------------------------------------------------------------------------------


Component: Generator, with Diesel Engine Driver
  Failure: Fails to Run                     Records Entered: 82, Aggregated: 82

-----------Demand-Aggregations-------------------------Hourly-Aggregations-------------
                                          |
       Median:  7.511E-003                |         Median:  2.564E-003
  Upper Bound:  2.531E-002                |    Upper Bound:  1.184E-002
---------------------------------------------------------------------------------------
```

Electrical Component Failure Event Aggregations

Component: Generator, with Diesel Engine Driver
Failure: Fails to Start
Records Entered: 82, Aggregated: 82

Demand-Aggregations		Hourly-Aggregations	
Median:	3.703E-003	Median:	------E----
Upper Bound:	1.367E-002	Upper Bound:	------E----

Component: Generator, with Hydro Turbine Driver
Failure: Fails to Operate Group
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	2.950E-003	Median:	------E----
Upper Bound:	4.652E-003	Upper Bound:	------E----

Component: Generator, with Hydro Turbine Driver
Failure: Fails to Start
Records Entered: 1, Aggregated: 1

Demand-Aggregations		Hourly-Aggregations	
Median:	2.950E-003	Median:	------E----
Upper Bound:	4.652E-003	Upper Bound:	------E----

Component: Generator, with Gas Turbine Driver
Failure: Fails to Operate Group
Records Entered: 2, Aggregated: 2

Demand-Aggregations		Hourly-Aggregations	
Median:	3.357E-002	Median:	2.039E-004
Upper Bound:	4.532E-002	Upper Bound:	6.609E-004

Electrical Component Failure Event Aggregations

Component: Generator, with Gas Turbine Driver
Failure: Fails to Run
Records Entered: 1, Aggregated: 1

Demand-Aggregations	Hourly-Aggregations
Median: ------E----	Median: 2.039E-004
Upper Bound: ------E----	Upper Bound: 6.609E-004

Component: Generator, with Gas Turbine Driver
Failure: Fails to Start
Records Entered: 1, Aggregated: 1

Demand-Aggregations	Hourly-Aggregations
Median: 3.357E-002	Median: ------E----
Upper Bound: 4.532E-002	Upper Bound: ------E----

Component: Power Electronics (Solid-state)
Failure: Fails to Operate Group
Records Entered: 8, Aggregated: 8

Demand-Aggregations	Hourly-Aggregations
Median: ------E----	Median: 5.429E-006
Upper Bound: ------E----	Upper Bound: 2.525E-005

Component: Power Electronics (Solid-state)
Failure: Fails to Operate
Records Entered: 8, Aggregated: 8

Demand-Aggregations	Hourly-Aggregations
Median: ------E----	Median: 5.429E-006
Upper Bound: ------E----	Upper Bound: 2.525E-005

Electrical Component Failure Event Aggregations

```
Component: Transformers, Control and Instrumentation
  Failure: Fails to Operate Group          Records Entered:  2, Aggregated:  2

-----------Demand-Aggregations-----------|------------Hourly-Aggregations------------
                                         |
          Median: ------E----            |          Median:  1.362E-006
     Upper Bound: ------E----            |     Upper Bound:  2.133E-005
-----------------------------------------|-------------------------------------------


Component: Transformers, Control and Instrumentation
  Failure: Fails to Operate                Records Entered:  2, Aggregated:  2

-----------Demand-Aggregations-----------|------------Hourly-Aggregations------------
                                         |
          Median: ------E----            |          Median:  1.362E-006
     Upper Bound: ------E----            |     Upper Bound:  2.133E-005
-----------------------------------------|-------------------------------------------


Component: Transformers, Power
  Failure: Fails to Operate Group          Records Entered:  7, Aggregated:  6

-----------Demand-Aggregations-----------|------------Hourly-Aggregations------------
                                         |
          Median: ------E----            |          Median:  4.752E-007
     Upper Bound: ------E----            |     Upper Bound:  2.309E-006
-----------------------------------------|-------------------------------------------


Component: Transformers, Power
  Failure: Fails to Operate                Records Entered:  7, Aggregated:  6

-----------Demand-Aggregations-----------|------------Hourly-Aggregations------------
                                         |
          Median: ------E----            |          Median:  4.752E-007
     Upper Bound: ------E----            |     Upper Bound:  2.309E-006
-----------------------------------------|-------------------------------------------
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13 ABSTRACT (200 words or less)

This volume of a five-volume series summarizes those data currently resident in the first release of the Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) data base. The raw human error probability (HEP) and hardware component failure data (HCFD) contained herein are accompanied by a glossary of terms and the HEP and hardware taxonomies used to structure the data. Instructions are presented on how the user may navigate through the NUCLARR data management system to find anchor values to assist in solving risk-related problems.

Volume V: Data Manual will be updated on a periodic basis so that risk analysis without access to a computer may have access to the latest NUCLARR data. Those users wishing to learn more regarding the computer-based interactive search and report-generation capabilities of the NUCLARR system are referred to the other volumes in the NUREG/CR-4639 series, e.g., Volume I: Summary Description or Volume IV: User's Guide.

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